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AGRICULTURAL AND ECONOMIC POSSIBILITIES OF OIL PALM CULTIVATION IN THE SULU ARCHIPELAGO

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MINDANAO DEVELOPMENT AUTHORITY
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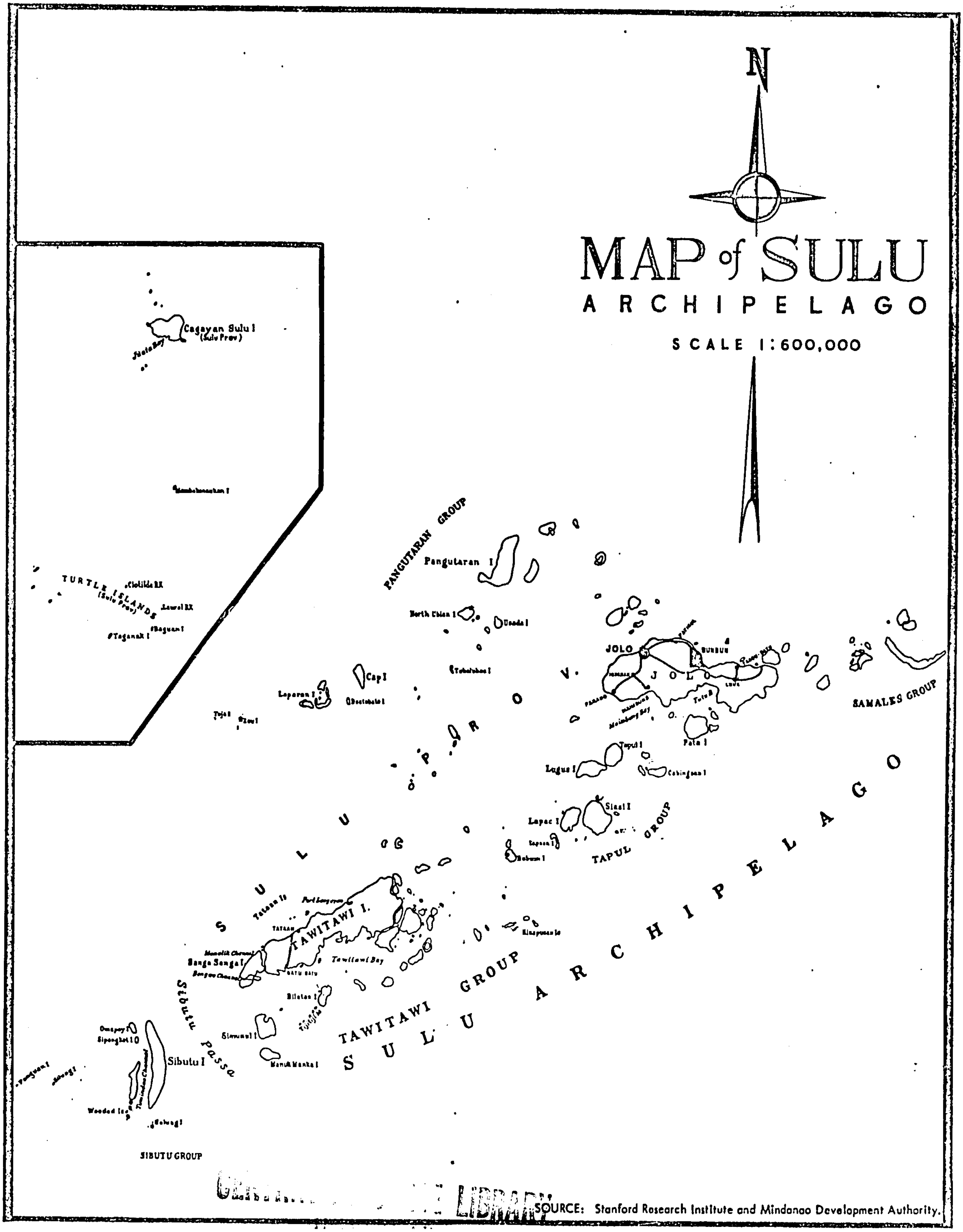

MAP of SULU ARCHIPELAGO

SCALE 1:600,000

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I INTRODUCTION

This study on the agricultural and economic possibilities of oil palm cultivation in the Sulu Archipelago was prepared under contract between the Mindanao Development Authority (MDA) and Stanford Research Institute (SRI). The contract provided for the preparation of three feasibility studies on industrial development that had a priori evidence of being suitable for the areas concerned, that is, Mindanao, Palawan, and the Sulu Archipelago. The contract provided further that a general report would be prepared on the three regions.

The industrial feasibility report on Mindanao deals with the establishment of an industrial estate for small- and medium-scale industry, and the report dealing with the Palawan area covers the feasibility of establishing an integrated fish canning industry.

This third report, directed toward the Sulu Archipelago, reveals that oil palm cultivation is agriculturally and economically feasible in the area selected for study, the island of Jolo--the largest island in the group lying between the province of Zamboanga del Sur in southern Mindanao and North Borneo. The report points out that areas on the island of Mindanao may also be feasible for oil palm cultivation and, in fact, may give monetary returns per hectare that may even surpass those of Jolo.

Owing to a lack of specific technical data, a number of assumptions have been made with respect to the land selected for study and the prevailing weather conditions. In each case, these are clearly set forth in the report. The results of tests now being conducted at the Royal Tropical Institute in Amsterdam on soil samples taken from the land under study will become a supplement to this report once they have been evaluated by the author.

The study incorporates the applicable laws and regulations governing industrial development and investment in the Philippines. However, more detailed information may be obtained from the respective government departments and bureaus in Manila, from the Philippine and American Chambers of Commerce located in Manila, and from the Philippine Embassies and Consulates abroad.

This report was prepared by Johannes Werkhoven, Agricultural Consultant, currently employed by the Department of Agricultural Research, Royal Tropical Institute, Amsterdam; he holds the Master of Science Degree in Tropical Agriculture, Agricultural University, Wageningen, Netherlands. During the years 1935-58, Ir. Werkhoven was research officer, head of the Agricultural Service, and Agricultural Adviser of the Handelsvereniging "Amsterdam" (H.V.A.), Sumatra, Indonesia, in the fields of oil palm, tea, rubber, and fiber crops. In his advisory work in the mentioned fields of specialization, he has undertaken surveys and consulting work in Peru and Turkey, and has made a study of the possibilities for the establishment of an oil palm estate in Panama.

Marcial O. Manalaysay, Assistant General Manager for Planning and Research, and Dominador J. Santos, Assistant General Manager for Program Implementation of the MDA, provided guidance and supplied support through their respective MDA staffs. Pedro Quial and Alex M. Ramos were of special assistance. The maps included in this study were prepared by Diosdada de Leon of the MDA. The study was performed under the administrative direction of Harry J. Robinson, Senior Industrial Economist, who was the SRI Project Manager. He also contributed to the section dealing with proposed methods of finance.

Field work for this report started in September 1964. The major areas visited included Basilian Island* and the island of Jolo. Brief visits were made to the islands of Siasi, Tawitawi, and Palawan. The visit to Palawan, made under conditions of inadequate transport and difficulty in reaching certain outlying regions, is discussed in a short report by Ir. Werkhoven, "Agricultural Development in the Philippines with Special Reference to Palawan Island."

During the study, Ir. Werkhoven provided technical advice and assistance to many agriculturalists and government officials connected with agricultural extension work and development. He also provided information on soil analysis and the latest methods for obtaining climatic data as a basis for further agricultural studies.

Stanford Research Institute and Ir. Werkhoven wish to express appreciation for the helpful cooperation and guidance received from the MDA's Board of Directors and staff, the officials of the Philippine National

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* The plantations of B. F. Goodrich, Hans Menzi, Walter Boelsterli, and the Philippine University.

Government and the Provincial Governments in Sulu and Palawan, and the MDA assistants who accompanied Ir. Werkhoven in the areas under study.

The Institute also wishes to acknowledge the hospitality extended by Princess Tarhata Kiram of Jolo and by Congressman Salih Ututalam from Sulu Province.

II SUMMARY AND CONCLUSIONS

This study has been conducted to determine the feasibility of establishing an oil palm plantation in the Sulu Archipelago.

Since only the Kiram Land Grant on the island of Jolo showed realizable potentialities, this study concerns the agricultural and economic possibilities of palm oil production in that area exclusively. The island of Mindanao was not included in the survey, but it is assumed that several parts of Mindanao may have better possibilities for oil palm cultivation than Jolo.

Of all the oil-producing crops in the world the oil palm gives the highest yield of oil per hectare, producing both palm oil and palm kernel oil.

So far palm oil is sold mainly on the world market, but it is finding an increasing outlet on the home markets of the producing countries. There is an increasing world demand for palm oil and kernels. Apart from superior oil yield, the production of palm oil has the following advantages:

1. Production cost is relatively low, under good exploitation conditions, resulting from high yields of palm oil and palm kernel oil.
2. Cultivation of the oil palm under efficient management and sound plantation practices will be conducive to soil protection and conservation.
3. Oil palm cultivation provides year-round labor for many workers. A plantation in full operation requires approximately 0.33 men per hectare, of which about 10 percent are skilled personnel.
4. The products of the palm--the palm oil and the palm kernel oil--have various end-uses.

Since the oil palm industry requires heavy capital investment for the plantation and the factory, efficient management, and good husbandry, it is normally cultivated on a plantation scale. Worthwhile monetary returns do not commence before about the ninth year after planting.

In countries with already advanced oil palm cultivation the crop can also be handled by small landholders using the manually operated, small processing equipment now available. For the time being, however, the oil palm is not a crop for the Philippine small landholder.

Under optimal conditions the oil palm is capable of yielding 24 tons of bunches at 21.5 percent oil recovery, i.e., 5.2 tons of oil, and 0.96 tons of kernels per hectare per year.

The study shows that on the basis of information available at this writing the environmental conditions of the Kiram Land Grant have to be considered suboptimal and the yield estimated accordingly, viz., 17.5 tons of bunches at 20 percent oil recovery, i.e., 3.5 tons of oil, and 0.74 tons of kernels per hectare per year.

Out of approximately 4,000 hectares of land belonging to the Kiram Land Grant, an area covering 1,500 hectares was selected, being considered suitable for oil palm plantation on the basis of topography, location, and compactness.

The study shows that, under the suggested methods of financing, palm oil production on the selected 1,500-hectare plantation with an estimated annual per-hectare yield of 17.5 tons of bunches at 20 percent oil recovery and 0.74 tons of kernels would be economically feasible if the oil were to be sold on the home market and the kernels exported. The proposed method of finance (₱8,000,000 capitalization) shows a profitable return, the net profit-to-capital ratio being estimated at 37.9 percent through the years 1990 to 1995, with a peak of 47.3 percent in 1979 prior to the payment of taxes, which are applied starting in 1980.

Should the plantation under study be established in the immediate future, it would reach full production in the late seventies with an average annual output of 5,000 tons of palm oil and 1,065 tons of kernels per hectare; this average production level would be maintained for a period of 18 years.

The home market requirements of the Philippines, amounting to some 5,000 tons of palm oil annually and increasing by approximately 3 to 5 percent per year, should be about 8,000 tons by mid 1978. These figures show that there would be a ready domestic market for the palm oil to be produced on the Kiram Land Grant, while the kernels could easily find an outlet on the world market.

Successful cultivation of the oil palm, which is practically a new crop in the Philippines, can, of course, only be achieved under conditions of peace and order, efficient management, and disciplined labor, supervised by men conversant in all aspects of oil palm cultivation and processing.

The first years of operation, through 1974, would require an investment in the plantation of ₱9,285,200 for the capital investment, plus ₱4,109,728 operating costs, less ₱1,678,000 income received, or a total of ₱11,716,928. An additional ₱624,000 would be spent between 1974 and 1978 for factory expansion, wharf, and pumphouse, bringing the total investment to ₱12,340,928. However, from 1975 on, the total income would exceed total expenditures, so that by 1995 the MDA should have received a total return of ₱85,366,232--₱78,332,738 net profit and ₱7,033,494 in the form of depreciation reserves.

One suggested method of financing is to consider the plantation as a continuing activity of the MDA; under such a plan, the expenditures for each year of operation until a net profit is reached would be deducted from the MDA's annual appropriations. From 1995 on, a replanting schedule should be established, since the yields would start to decrease and harvesting would become uneconomical.

A second method of financing would be to establish a corporation in 1975, when net profits exceed expenditures. The MDA would incorporate the plantation at ₱8,000,000 with 51 percent of the shares to be held by the MDA, so that the plantation would then become a subsidiary corporation and as such entitled to the five-year tax-free holiday. In the following five years, the tax rate would increase 20 percent annually, reaching 100 percent in 1984.

By this division of ownership, the MDA would hold shares valued at ₱4,080,000 and would receive ₱3,920,000 through the sale of 49 percent of the shares to the private sector. The difference between the ₱8,000,000 capital and the total expenditures of ₱11,717,000, which would amount to ₱3,717,000, would be considered as a 15-year loan from the MDA to the corporation, at 8 percent interest. The remaining capital expenditures of ₱250,000 for the construction of a pier and pumphouse, and ₱374,000 for the last phase of the machinery and equipment, or a total of ₱624,000, could be financed either directly from profits or through three short-term loans for two years, each at 8 percent interest. The latter method has been considered in the study, as it would make the return per share more attractive to the potential buyers in the initial years of operation as a corporation. The net profit-to-equity ratio for 1975 has been estimated at 6.3 percent, increasing to 47.3 percent in 1979. The net profit-to-equity ratio for 1983, when the tax-exemption privilege terminates, would be 35.5 percent, increasing to 37.9 percent through the years 1990 to 1995 after the suggested 15-year loan to the MDA has been repaid (1989).

Since by law the corporation can hold only 1,024 hectares, the remaining 476 hectares would be leased by the MDA to the corporation, the annual rental per hectare to be set at the time of incorporation.

III THE IMPORTANCE OF THE OIL PALM

The African oil palm, Elaeis guineensis, is one of the few palms that yield a commercial oil from both the fleshy outer layer (the pulp, or mesocarp or pericarp) of the fruits and the seed kernel.

The oil obtained from the pulp is the palm oil of commerce, and the oil from the kernels (the seeds) is the so-called "palm kernel oil." Palm oil and palm kernel oil are different in their constitution and properties, although some of their end-uses are similar.

Palm oil contains glycerides of both saturated and unsaturated fatty acids. The main saturated acid is palmitic, which is of special value in soapmaking. Oleic and lineoleic are the main unsaturated acids. Palm oil contains carotene (a precursor of vitamin A) which imparts the typical red color to the oil. As compared with African palm oils, the oils in the Far East (Indonesia, Malaysia) have a rather low content of carotene; this is actually an advantage as such an oil is easier to bleach and, therefore, is suitable in manufacturing the white oil products preferred by many consumers.

In addition to the manufacture of soap, palm oil also is used in edible products such as margarine, cooking fats, and shortenings. It has an important use in the tin-plating industry as a coating which protects the hot metal sheet against oxidation.

Palm kernel oil, as distinguished from palm oil, is closely akin to coconut oil and can be put to similar uses; it is used in making soap and edible products, particularly margarine and confectionary. The palm kernel oil, like coconut oil, contains lauric acid which makes it emminently suitable for the production of high-quality soaps.

Moreover, palm kernel oil, like coconut oil, is finding a new outlet in the chemical industries for the production of synthetic detergents having a lauric acid base. The majority of the kernels are exported from the producing countries to western Europe, because after the oil has been expressed, the residual cake has a considerable value as a cattle feed, for which in most producing countries there is presently little demand. In this respect, the high cost of crushing equipment has also to be considered.

Apart from the palm's superior yield the production of palm oil has the following advantages:

1. Production cost is relatively low, under good exploitation conditions, resulting from the high yields of palm oil and palm kernel oil.

2. The cultivation of the oil palm under competent management is conducive to soil protection and conservation, both factors of considerable importance in the tropics in general and in the Philippines in particular. A serious decline of soil fertility is of common occurence in many places of the Minsupala area* owing to maltreatment of the soil and soil erosion.

3. The oil palm is not a seasonal crop. It provides activities and income throughout the year to a large labor force which otherwise might be idle or might misuse the natural resources through the poor husbandry practices of small landholder farming. The normal cropping activities on the small farms often lead to considerable waste of the soil, water, forest vegetation, and other natural resources.

4. The products of the oil palm--the palm oil and the palm kernel oil--have various end-uses.

Finally it should be noted that the prospects for breeding and selecting higher-yielding oil palms in the future are very promising. It can be expected that after each economic lifetime of a plantation, i.e., a period of some 25 years, planting material of an ever increasing yield capacity will be available for replanting (interplanting under the old stand).

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* Minsupala comprises Mindanao, Sulu, and Palawan.

IV DEVELOPMENTS IN PRODUCTION, TRADE, CONSUMPTION, AND PRICES OF OILS AND FATS SINCE BEFORE WORLD WAR II*

"World production of all fats and oils increased by about 50 percent between [before World War II] and 1960-61. Production has more than doubled in North America, which has now become the world's largest producing area, and it increased by about 40 percent in Western Europe. In Africa and Latin America, production has also expanded considerably since before the war, while in Asia, the world's largest producing area before the war, there was only a modest increase of about one-fifth. World production of nontropical vegetable oilseeds and oils rose between pre-war and 1960-61 by about 65 percent, mainly because of a three-fold increase in soybeans, while production of tropical oilseeds and oils increased less rapidly, by about 45 percent.

World Exports

"World exports of all oils and fats increased between pre-war and 1960-61 by about 35 percent, i.e., less rapidly than output. North America changed from a net importing to a net exporting position and is now the world's largest exporting area, while in Asia and Latin America, exports declined. In Africa, the rise in exports, although important, was smaller than the rise in output. In tropical countries the share of production which went into exports declined from nearly 60 percent before the war to about 45 percent in 1960-61, whereas an illustrative example of an opposite development are the slaughter fats for which the share of world exports in world production rose from 7 percent before the war to 17 percent in 1960-61.

"World exports of animal fats and marine oils increased by nearly three-quarters between the pre-war and 1960-61. Oilseeds and vegetable oils taken together increased only moderately, by about one-fifth; exports of soybeans and soybean oil, however, nearly trebled, while exports of tropical oilseeds and vegetable oils increased only slightly, their share falling from about 45 percent before the war to about 35 percent of total world exports of oils and fats in 1960-61.

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* The early paragraphs and Table 1 of this section are extracted from Trade in Tropical Products, GATT Program for Expansion of International Trade, Geneva, 1963. Author's notes appear in brackets.

"World exports of vegetable oils increased between pre-war and 1960-61 by about 1.2 million tons (of which about 500,000 tons was an increase in exports of soybean oil and cottonseed oil, and 350,000 tons in those of tropical oils), while oil equivalent of world exports of oilseeds slightly declined. Moreover, an important shift occurred in the pattern of world exports of oilseeds, reflecting the supply conditions and the preference of crushers in the main importing areas for seeds giving a higher cake-protein ratio; world exports of soybeans more than doubled, while those of tropical vegetable oilseeds (in oil equivalent), taken together, declined.

World Imports

"In the high-income countries of North Western Europe (i.e., excluding the Mediterranean countries other than Italy) imports of oils and fats increased by about 15 percent between 1954-55, when they stood at about their pre-war level, and 1959-60. This group of countries is still the major market for oils and fats, but its share in total world imports has declined to less than two-thirds in 1960-61, while lower-income countries in Europe and in other parts of the world, which together doubled their imports during the same period, became increasingly important outlets. Moreover, imports of animal fats and fish oil into North Western Europe have expanded faster than imports of vegetable oilseeds and oils, which increased between pre-war and 1959-60 by only about 10 percent, or 300,000 tons (oil equivalent); in the lower-income countries in Europe and in other parts of the world, the increase in imports of vegetable oils during the same period was of about 700,000 tons.

"As regards the pattern of imports of vegetable oilseeds and oils into North Western European countries, significant changes occurred between pre-war and 1954-55 as well as during the second half of the nineteen fifties. Imports of soybeans into the countries of the EEC, taken together, and into the United Kingdom trebled, while those of tropical oilseeds either declined or, in a few cases, rose only moderately; during the same period the imports of tropical oils declined slightly in the United Kingdom and remained practically unchanged in the countries of the EEC, taken together.

Consumption

"In North America there was practically no increase in consumption per head of oils and fats between pre-war, when it had already reached a level close to 30 kgs., and 1960-61. In Western Europe, there was a moderate increase during the same period, reflecting especially above-average increases in the lower-income countries, and consumption per head of oils and fats in the area in 1960-61 is estimated at about 26 kgs. A more rapid increase in consumption took place since pre-war in Latin America, where consumption per head is on the average, however, still not much higher than 10 kgs. per head. By contrast, in Africa and in Asia, where the per capita consumption level before the war was below 5 kgs., there were generally only very modest increases.

Prices

"The index numbers calculated by the FAO show that there was during the second half of the fifties a relatively slow, but steady decline in prices for the group of oilseeds, as well as for that of oils and fats as a whole, which in 1961 were both by about 10 percent lower than in 1952-54; this decline was shared by all fats and oils listed in [Table 1], with the exception of palm oil. Table 1 shows the development of prices of various oils in relation to the price of soybean oil during the second half of the fifties.

Table 1

DEVELOPMENT OF PRICES OF VARIOUS OILS IN RELATION TO SOYBEAN OIL
Average 1956-57, years 1959 through 1961, and January-June 1962
(Dollars per Ton)

Oil	1956-57	1959	1960	1961	1962 (Jan.-June)
Soybean	$ 323	$ 232	$ 224	$ 287	$ 247
Coconut	-68	+135	+75	-49	-12
Groundnut	+42	+68	+103	+43	+43
Palm	-67	+6	0	-59	-30
Fish	-127	-70	-81	-151	-134

Note: The differences between the prices of soybean oil and those of coconut, groundnut, palm, and fish oil shown are based on quotations on various markets.

Production of Palm Kernels and Palm Oil

"The principal producers of palm kernels and palm oil are Nigeria, Congo (Leopoldville), Indonesia, and Malaya. [See Table 2.] They account for 70 percent of the output of palm kernels and 90 percent of palm oil production. Other producers of palm kernels are Sierra Leone, Dahomey, Ivory Coast, Guinea, and in the case of palm oil, Dahomey. Congo (Leopoldville) is the only indigenous exporter with an important crushing industry and exports the major part of its production of palm kernels as oil . . . On the whole the production of oil palm products is to a very large extent directed toward exports as [shown in Table 3].

"Western Europe absorbs about 90 percent of all imports of oil palm products. In 1960 the area imported about 850,000 tons, most of the rest going to North America, Japan, and India.

"Production of palm kernels increased by about 20 percent during the 1950's nearly all of which occurring in Nigeria and other countries in West Africa, including the Congo (Leopoldville). Production has been declining in the main countries in the last few years, and total production in 1961 was no larger than in 1954-55. This observation also holds true for the level of palm oil production which has not moved significantly in recent years.

"In the export trade, palm oil has gained some ground, whereas exports of palm kernels, both in the form of kernels and oil (principally from the Congo among the less-developed countries), declined in the last three years. Palm oil exports were better maintained and showed only minor movements. Incomplete data for 1962 point at a slight fall in both palm kernel and palm oil exports in comparison with 1961. Palm kernel oil exports from the Congo also dropped.

"The only importers of these products of some significance outside Western Europe are the United States and Japan. With the exception of United States imports of palm kernel oil, imports of these areas have recently been weakening. Western Europe's imports of palm kernels declined from about 350,000 tons in 1954-55 to 300,000 tons in 1960-61.

"Since the beginning of the 1950's Europe's share in imports of palm oil has dropped from over 90 percent to below 80 percent. The quantity imported by Western Europe has, however, declined only slightly, from about 460,000 tons in the mid-fifties to 450,000 tons in 1960-61. There was a continuous decline in imports by the United Kingdom, the largest market. Increased imports are noted for the United States and Canada, and for some countries in Asia, in particular India and Japan.

Table 2

PALM KERNELS AND PALM OIL PRODUCTION
1948-1962
(Thousands of Metric Tons)

Continent and Country	Palm Kernels (Palmistes)						Palm Oil (Huile de palme)					
	1948-49 1952-53	1957-58	1958-59	1959-60	1960-61	1961-62	1948-49 1952-53	1957-58	1958-59	1959-60	1960-61	1961-62
Central and South America												
Brazil[a]	76.4	87.2	94.2	85.1	100.7	117.8	--	--	--	--	--	--
Costa Rica	4.5[b]	--	--	--	--	--	20.6[b]	5.4	3.7	3.6	3.6	--
Ecuador	5.5[b]	--	--	--	--	--	--	--	--	--	--	--
Honduras	0.2[c]	0.5	0.7	0.7	0.7	--	30.6[c]	--	--	--	--	--
Mexico	10.6	20.9	21.4	23.3	--	--	--	11.8	11.8	12.4	--	--
Nicaragua	--	--	--	--	--	--	0.4[b]	--	--	--	--	--
Paraguay	--	--	--	--	--	--	1.1[d]	--	--	--	--	--
Total	100	140	150	140	160	170	--	23	21	22	--	--
Asia												
Federation of Malaya[e]	10.8	15.0	18.6	19.6	24.1	24.6	49.2	59.4	70.6	72.7	91.6	94.8
Indonesia[e]	28.5	39.5	35.3	33.3	33.1	34.4	113.9	160.2	147.7	137.5	141.2	145.6
Total	39	55	54	53	57	59	163	220	218	210	233	241
Africa												
Angola[f]	11.1	12.6	13.7	7.5	5.2	10.2	--	18.5	19.0	--	--	--
Cameroon	28.0	23.4	18.5	21.0	16.3	--	--	25.4	16.6	--	--	--
Congo (Leopoldville)[g]	117.0	146.1	143.8	161.7	142.2	127.0	172.2	233.5	225.1	245.2	233.7	223.5
Former French Equatorial Africa												
Central African Republic[f]	--	0.7	0.8	0.8	1.2	1.0	--	0.7	--	--	--	--
Congo (Brazzaville)	--	6.5	7.1	6.2	6.5	6.6	--	4.7	4.6	5.0	5.2	--
Former French West Africa												
Dahomey[f]	--	44.7	60.0	43.8	61.3	48.5	--	--	--	--	--	--
Guinea[f]	--	20.5	19.4	21.2	23.0	22.9	--	--	--	--	--	--
Ivory Coast[f]	--	12.0	17.3	14.6	16.4	12.5	--	6.4	7.5	12.2	18.5	20.3
Senegal	--	1.6	2.3	3.0	4.2	4.9	--	--	--	--	--	--
Gambia[f]	1.6	1.1	1.5	1.8	1.6	1.6	--	--	--	--	--	--
Ghana[f]	4.7	7.1	8.1	2.9	3.1	1.8	--	--	--	--	--	--
Liberia[f]	17.2	10.6	11.1	19.3	15.2	12.9	46.5[h]	39.0	--	--	--	--
Nigeria[i]	376.4	418.5	468.1	435.3	428.8	437.3	(351.0)	(410.0)	(457.0)	(433.0)	(423.0)	(403.0)
Portuguese Guinea[f]	15.4	14.3	16.1	15.0	6.8	8.5	--	--	--	--	--	--
Ruanda-Urundi (former)	0.3[b]	0.2	0.2	0.2	--	--	1.3[b]	1.7	1.2	1.1	1.0	1.0
Sao Tomé and Principe[f]	6.0	4.5	4.3	3.8	4.4	3.7	--	2.3	2.1	2.0	--	2.0
Sierra Leone[f]	74.3	53.8	55.5	58.5	55.4	58.7	--	--	--	--	--	--
Spanish equatorial region	--	3.9	4.9	3.7	--	--	--	4.1	4.3	3.0	--	--
Tanganyika	--	0.4	0.1	0.9	0.8	0.9	--	0.1	0.1	0.1	0.1	0.3
Togo	9.0	6.2	12.0	8.1	13.5	11.1	--	2.2	2.2	2.5	0.5	--
Total	740	790	870	830	810	800	800	900	930	920	890	870
World total	880	990	1,070	1,020	1,030	1,030	970	1,140	1,170	1,150	1,140	1,130
Regional totals												
Latin America	100	140	150	140	160	170	--	23	21	22	--	--
Far East	39	55	54	53	57	59	163	220	218	210	233	241
Africa	740	790	870	830	810	800	800	900	930	920	890	870

Notes: Figures in brackets are FAO estimates. Totals also include estimates for Surinam and Venezuela in Central and South America.

a. Babassu kernels.
b. 1952/53.
c. Average of three years.
d. Average of four years.
e. Estates only.
f. Palm kernel data relate to exports.
g. Plantation production and production from fruits delivered by native growers.
h. Average of two years.
i. Palm kernel data relate to purchases for export.

Source: Production Yearbook, FAO, Vol. 16, 1962, p. 115.

Table 3

PRODUCTION AND EXPORTS OF PALM OIL
1960-1961
(Thousand Tons)

Exporting Country	Production (1960-61) Palm Kernels	Production (1960-61) Palm Oil	Exports (1961) Palm Kernels (oil equiv.)	Exports (1961) Palm Kernel Oil	Exports (1961) Palm Oil
Nigeria	437	176	178	--	167
Congo (Leopoldville)	(127)	(223)	3	49	153
Sierra Leone	61	--	25	--	--
Dahomey	49	(11)	21	--	11
Indonesia	35	145	14	--	118
Malaya	(25)	94	9	--	96

Source: Commonwealth Economic Committee, Tropical Products Quarterly, December 1962.

Factors Influencing Production and Utilization of Tropical Oilseeds

"As regards production, there are a number of technical factors--leaving aside economic incentives such as prices received by producers--which significantly affect the level of production. Among the tropical oilseeds, only groundnuts are annual crops, production of which can be expanded fairly rapidly--under the assumption that economic incentives are present--provided that there is scope for expanding the planted areas and improving the yields. An increase in production from tree crops takes longer to achieve. Oil palms are most profitable as a plantation crop which yields a return only after about five years, when the trees reach bearing age. [With modern planting material and under good conditions, economical harvesting begins after 3.5 years.] In the case of coconut palms, largely a smallholder's crop, the main need is for strong government support for research and extension work.

"On the demand side tropical oils are competing for many uses, both food and nonfood, with a great number of other fats and oils. There are large possibilities for substitution between the various tropical oils, on the one hand, and between these and nontropical vegetable oils, marine oils, butter, and slaughter fats, on the other.

Prospects

"Assuming that prices and agricultural policies would remain unchanged during the sixties, projections of demand and production of fats and oils were made by the FAO* for the various areas of the world. In Western Europe the increase in total demand for oils and fats, because of the progressive approach of the saturation point in most countries, is expected to increase only moderately at an annual rate of less than 2 percent. Moreover, as supplies from domestic production of butter and of slaughter fats are expected to continue to rise substantially, imports of vegetable oilseeds and oils are likely to increase less rapidly in the sixties than in the previous decade, by just over 1 percent per year.** Prospects for imports of tropical oilseeds and oils are even less promising--under the assumption of unchanged prices and a continuation of past production trends--if the present comparative price advantage of soybeans continues to prevail. In North America, as production of oils and fats is expected to rise (assuming a continuation of past trends) at a faster rate than consumption, exportable supplies, especially of soybeans and soybean oil, would rise rapidly during the sixties and would probably exceed outlets for commercial export. In Japan it is expected that import requirements of vegetable oils will rise substantially during the sixties.

"As regards low-income countries, it appears from the FAO projections that if domestic production increases in many of these countries are not going to be more rapid than during the fifties, they would not be sufficient for meeting the rapidly growing demand resulting both from high rates of population growth and the high income elasticity of demand. Production of the various types of tropical oilseeds is projected by the FAO, in general, on the basis of past trends to rise at a relatively faster rate in the case of groundnuts, especially in West African countries, than for palm kernels, palm oil, and copra, for which only moderate increases are projected."***

Another publication points out that the world demand for palm oil and palm kernels is likely to expand. Such an increase in demand would obviously depend on how the prices of palm oil and palm kernels compare with those of the other fats that most immediately compete with them. The publication concludes, "Of all the tropical oilseeds of world significance it is the oil palm which seems capable of the biggest increase in production on competitive terms without adverse effects on the diversification of the local economics."*

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* Data are given in "Agricultural Commodities, Projections for 1970," FAO, Rome, 1962.

** In the lower-income countries of western Europe a faster rate of increase in the consumption of oils and fats and in imports of vegetable oils can be expected. These countries, however, account at present for only a small part of the total imports of vegetable oilseeds and oils of western European countries, taken together.

*** End of material extracted from GATT program publication.

Palm Oil Prices

"Palm oil in recent years has tended to be linked not so much with coconut and palm kernel oils as with the soft vegetable oils and marine oils. Prices for palm oil also generally fluctuate much less than those of other edible oils. [See Table 4 for actual prices in the United Kingdom.] The decline in prices in 1962 was associated with the cheap whale and fish oils; palm oil world supplies were in fact lower than in 1961. A recovery in prices began late in 1962, as with marine oils and the soft oils, and it continued steadily throughout 1963; by December, prices were the highest for nearly two years. In the early months of 1964, prices increased a shade further, Malayan oil rising to £84 10s per ton."**

"World Supply of Palm Oil Continues to Rise"

"In Calendar year 1963 the world net exports of palm oil according to our preliminary calculations increased by 18,000 T to 521,000 MT. The sizable declines in the exports from the Republic of Congo were more than offset by larger shipments from Malaya, Singapore, Indonesia, and Nigeria. This trend is expected to continue in 1964 with most of the increase anticipated from Nigeria where production is expected to continue to rise as a result of the increase in producer prices by £1 per LT. In addition, part of the increase in 1963 production was not yet shipped by the end of the year. While purchases increased by 19,000 T, exports probably rose only some 8,000 T to an estimated 128,000 MT. Indeed, the export figures for the last two months of the year are estimated. On a world basis we reckon for 1964 with net export supplies of 540,000 MT. i.e., 19,000 T more than the actual net exports of last year but still 45,000 T below 1960.

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* Extracted from Oilseeds, Organization for European Economic Cooperation, Paris, 1957, p. 307.

** Extracted from Vegetable Oils and Oilseeds, Commonwealth Economic Committee, London, 1964, p. 164.

Table 4

MIDMONTH PRICES OF PALM OIL IN THE UNITED KINGDOM, PER TON[a]
1959-1963
(Pounds, Shillings)

Month	1959		1960		1961		1962		1963	
January	£ 84	10s	£86	0s	£82	0s	£85	0s	£79	0s
February	84	10	85	0	85	0	86	0	79	0
March	87	0	82	10	86	0	82	0	79	0
April	--	--	82	10	87	0	80	0	79	0
May	97	0	82	10	87	0	79	0	79	0
June	101	0	82	10	86	10	78	0	79	0
July	--	--	82	0	84	0	78	0	80	10
August	--	--	82	10	83	0	76	0	81	10
September	83	0	82	10	83	0	75	0	81	10
October	83	0	81	10	83	0	71	0	82	10
November	84	10	82	0	83	0	76	0	83	10
December	85	10	83	0	83	0	77	0	84	0
Yearly average	£	s	£82	15s	£84	5s	£78	5s	£80	15s

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a. Five percent Malayan, nearest forward shipment, c.i.f. United Kingdom ports.

Source: Vegetable Oils and Oilseeds, *op. cit.*

"The larger world supplies of 1963 were mostly absorbed by West Europe, chiefly by West Germany, the Netherlands, and France. But also India, Japan, and Malaya-Singapore took some larger amounts. As against this, the imports into the U.S.A. and Canada declined sizably. The total 1963 world imports according to our preliminary calculations increased 40,000 T, with part of the increase stemming from larger supplies shipped towards the end of 1962.

"The world market prices for palm oil once more advanced somewhat in January, following the announcement of the Nigerian Marketing Board of an increase in 1964 producer prices by £1 per LT. However, the world market price level reached could not be maintained long as the prices for marine oils as well as for the most important seed oils gave way in January and February. At the beginning of February the world market price for Nigerian palm oil, too, was reduced by £1, and since that time it has been at £82 10s or 10s below the opening level of early January. Further indications are for continued stable palm oils prices, despite the further rise in world market supplies. Owing to the reduced supplies of marine oils, the consumption of palm oil is likely to continue to increase. The prices for the most important competing commodities, marine oils, lard, and seed oils, are not expected to decline further during the second quarter of 1964 so that palm oil will not come under new pressure from this side."*

Palm Kernel Prices

"World prices of palm kernels and palm kernel oil usually follow very closely those of copra. . . . As with copra, quotations in the later months of 1963 were the highest for well over three years, and average prices were the highest for three years. [See Table 5.] Prices in the early months of 1964 showed a somewhat easier tendency, palm kernels in mid-April being £53.5s and palm kernel oil £101 per ton."**

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* Extracted from Oil World Quarterly, April 1964.

** Extracted from Vegetable Oils and Oilseeds, op. cit., p. 163.

Table 5

MIDMONTH PRICES OF PALM KERNELS AND PALM KERNEL OIL, PER TON
1960-1963
(Pounds)

Month	Palm Kernels, Nigerian[a]								Palm Kernel Oil[b]							
	1960[c]		1961		1962		1963		1960		1961		1962		1963	
January	£71	0s	£52	0s	£47	15s	£56	0s	£134	0s	£96	0s	£ 86	0s	£103	0s
February	71	10	53	0	47	10	52	15	129	0	98	10	85	10	97	0
March	68	0	50	10	47	10	52	5	127	0	97	0	85	0	95	0
April	61	0	49	10	49	0	53	0	117	0	91	10	90	10	95	10
May	58	0	49	0	49	0	52	15	112	0	89	0	88	10	96	0
June	57	0	46	10	47	0	54	0	109	0	88	0	85	0	97	5
July	56	10	50	0	47	5	55	0	110	0	91	0	83	10	101	0
August	57	0	50	10	49	0	55	10	108	10	94	0	84	0	101	0
September	--	--	48[c]	0	49	0	55	10	100	0	90	15	84	0	101	0
October	50	10	48	0	50	0	60	10	96	10	89	10	86	10	107	0
November	53	0	47	10	54	0	60	0	100	0	85	10	96	10	107	0
December	50	0	46	15	56	0	57	15	97	0	83	10	102	0	109	0
Yearly average	£59	10s	£49	5s	£49	10s	£55	5s	£111	15s	£91	5s	£ 88	5s	£100	15s

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a. Nearest forward shipment, c.i.f. United Kingdom ports.
b. Net, naked, ex mill, London.
c. Malayan.

Source: *Vegetable Oils and Oilseeds*, *op. cit*.

V PALM OIL IN THE PHILIPPINES

Production

So far there is no significant domestic production of palm oil and palm kernels (and palm kernel oil) in the Philippines.

Imports

The Philippine imports of palm oil* were as follows:**

from Indonesia in 1959, 1960, and 1961--
4.9, 5.1, and 6.4 thousand tons, respectively;

from Malaya in 1959 and 1960--
0.4 and 0.3 thousand tons, respectively.

According to the same source the total Philippine imports of palm oil in thousands of tons were:

1955	1956	1957	1958	1959	1960	1961
3.0	7.1	4.6	5.3	4.8	4.9	(6.5)

In addition, in 1959, 4,528 kg of kernels at a value of ₱1,787 were imported.***

Table 6 gives data for Philippine imports of palm oil and palm kernel oil. The figures show that the Philippines yearly imports some 5,000 to 7,000 tons of palm oil, which mainly are used for edibles such as margarine and shortening. Since an increasing demand is to be expected due to population growth and increased consumption per capita (some 5 percent annually), it may be concluded that a domestic oil palm plantation producing some 5,000 tons of oil annually would find a secure outlet for its produce on the home market. The oil palm plantation established in Basilan

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* Whether crude or refined is not specified.

** Data are from Vegetable Oils and Oilseeds, op. cit., pp. 143 and 145.

*** Ibid.

Table 6

PHILIPPINE IMPORTS OF PALM OIL AND PALM KERNEL OIL
1956-1963

	Palm Oil, Crude		Palm Oil, Refined		Palm Kernel Oil, Crude		Palm Kernel Oil, Refined	
Year	Quantity (kg)	Value (pesos)	Quantity (kg)	Value (pesos)	Quantity (kg)	Value (pesos)	Quantity (kg)	Value (pesos)
1956	7,261,836	₱3,073,608	--	₱ --	1,700	₱ 1,192	--	₱ --
1957	4,649,049	2,032,692	--	--	2,944	1,644	--	--
1958	5,424,174	2,255,034	--	--	633,005	281,787	--	--
1959	4,926,833	1,570,304	--	--	323,223	129,058	--	--
1960	5,039,995	2,020,989	--	--	464,894	189,767	--	--
1961	4,033,995	1,640,692	72,636	236,107	14,793	15,137	32,738	38,800
1962	4,842,273	--	341,736	--	673,437	--	148,138	--
1963	4,979,339	3,744,569	7,875	13,923	409,697	310,784	55	--

Source: Bureau of the Census and Statistics of the Philippines, Manila.

Island covers only an area of 230 hectares; it will start production on a low level after some four years and will produce at the most 900 tons of palm oil annually after ten years. The production of palm oil elsewhere in the Philippines is of no importance. Apart from the home market there are good possibilities for sale of the oil on the world market, e.g., Japan and the United States, provided that the Philippine palm oil is produced under favorable conditions resulting in a competitive cost price.

Price of Palm Oil in the Philippines

The c.i.f. world price is £80-£85 per metric ton, or approximately US$220-$235 or ₱880-₱940. The c.i.f. price now is ₱930-₱935, which brings the landed cost price in Manila due to duties, taxes, etc., to ₱1,230 per ton of palm oil.

From the foregoing it may be concluded that world demand for oils suitable for the production of edible fats and soap is increasing steadily due to the rising needs of the growing world population, and that palm oil and palm kernel oil rank first among the vegetable oils.

Among the oil-bearing crops the oil palm is the most favored, since this crop, as compared with other oilseeds, gives the highest yield in the world. The yields from coconut palms (750 to 1,000 kg of coconut oil per hectare) are only one-third or one-fourth of those from oil palms (2,500 to 5,000 kg of palm oil per hectare plus about 250 to 500 kg of palm kernel oil per hectare). Of all the tropical oilseeds of world significance it is the oil palm that seems capable of a big increase in production on competitive terms, at the same time favoring the diversification of the local economies.

VI THE OIL PALM

General

The palm is planted at a density of 125 to 150 palms per hectare. The fruit from which the oil is obtained grows in highly clustered bunches in the leaf axils. An average bunch from a mature palm weighs some 15 to 30 kg and contains 500 to 1,000 fruits.

The main types of oil palm are classified on the basis of the forms of fruits as follows:

1. The thick-shelled dura, either the African dura with thin pericarp, thick shell, and a good-sized kernel or the Deli dura, the common cultivated palm in the Far East, with larger fruits and a higher percentage of pulp per fruit than the African dura
2. The thin-shelled tenera
3. The shell-less pisifera

From a commercial point of view the third type can be considered as a "nonvaleur," being almost sterile and consequently not producing bunches of importance.

Modern planting material is tenera, potentially the highest oil yielder, which is a monofactorial hybrid between dura, either African or Deli, and pisifera. The ratio of palm oil to bunch is 17-18 percent for dura and may rise to as high as 22-24 percent for tenera. The amount of kernels per bunch weight is 4-6.5 percent and the kernel oil yield is 2-3.25 percent of the bunch weight. The commercial extraction rate of palm kernel oil from kernels is about 47 percent. In addition to approximately 4.5 tons of palm oil, a hectare of oil palms yields some 0.88 tons of kernels per year.

Under favorable conditions from modern high-yielding planting material five tons of palm oil plus about one ton of kernels per hectare per year may be obtained.

Harvesting of the oil palm starts some 3.5 years after planting, which compares to the inevitable five to seven years of nonproductivity for rubber, coconut palm, and other tropical tree crops. The initial yield is low, but the yield increases steadily until it reaches its maximum under good conditions in its eighth to tenth year (modern tenera are indeed quick starters). Thereafter, there is no marked decline, but 25 years from planting is about the economic life of a plantation; if for no other reason, after 25 years most palms become too tall to be harvested economically.

The oil palm bears fruit throughout the year, but normally there are some peak months. Harvesting, which is a matter of estate routine and discipline, takes from seven to ten days. The bunches should be harvested at the proper stage of maturity, for unripe fruit yield much less oil and overripe fruit yield oil containing too high a content of free fatty acid. The time between harvesting and processing should be kept to a minimum to avoid deterioration of the oil. Therefore, the extraction of palm oil must be carried out where the palms grow, but as stated above, most of the world commerce supply of kernels is processed in western Europe.

The procedure of oil and kernel production may be summarized as follows:

1. Collection and transport of bunches to factory
2. Sterilization of bunches
3. Stripping of bunches and digestion of fruits
4. Separation of oil from fruit
5. Washing and purification of the oil
6. Separation of nuts and pericarp residue
7. Drying and cracking of nuts and separation and drying of kernels (the dried kernels are bagged for shipping)

Environmental Conditions for the Oil Palm

Climate

The oil palm is a crop of tropical regions requiring for optimum oil yields:

1. A constant high temperature of 24°-28°C (with mean minima higher than 18°C and maxima lower than 32°C)

2. A well-distributed high rainfall of 2,000 to 3,000 mm per annum without prolonged dry periods

3. A high relative humidity of the air (monthly average higher than 75 percent)

4. Well-distributed sunshine with at least 1,500 hours a year

Owing to the temperature requirement, commercial growing of oil palms occurs only in the equatorial belt from 10°-12° N. Lat. to 10°-12° S. Lat., and at elevations up to 500 meters.

For successful palm oil production the climate is of primary importance, but in marginal areas soil quality is the decisive factor. It is not possible, therefore, to be categoric concerning rainfall and its distribution, as both soil and climatic conditions play an important part. Normally yields increase with total annual rainfall, but even with a rainfall of 1,700 to 2,000 mm good results can be obtained, provided that the rainfall is evenly distributed, relative humidity is high, and the soil has a high moisture-retention capacity.

Broadly speaking, the annual rainfall should not be less than 2,000 mm and evenly distributed; ideally there should be no month with less than 100 mm. In practice the dry season should last at most two to three months (a month is considered dry if rainfall is lower than 50 to 60 mm).

Soil

The oil palm grows in a large variety of soils, but a deep loamy soil, rich in humus and nutrients, with a well-developed structure, a loose friable consistency, and without impervious layers in the top 1.5 meters is the most desirable type for optimum oil production. Drainage must be good for aeration, and the soil must be capable of holding ample moisture, for the palm has a high water requirement. Growth will be adversely affected by a permanent high water table. Both sandy coarse soils and heavy badly drained soils are unsuitable.

The volume of soil available for good rooting of the palm is highly important. The greater the deviations from the optimum climatic conditions in a certain area, the larger and better the rooting volume should be. With regard to soil acidity, the best results in practice are obtained in soils with a pH range of from 4 to 6. In selecting soils for oil palms the physical properties of the soil should have highest priority, since the nutritional status of a poor soil can be improved by fertilization, whereas for practical and economic reasons a soil of poor structure and consistency quite often cannot be converted into an environment suitable for successful commercial palm oil production.

Since an ideal oil palm soil hardly exists, compromises must always be made, so that in practice a much less narrow range of soil types is used. The topsoil should always contain sufficient organic matter, say 1.5-2 percent C with a carbon-nitrogen (C/N) ratio of around 10. For good results large amounts of nutrients must be available; hence, for most soils a timely, regular, and adequate application of fertilizers is indispensable for high yields. In particular, potash is in heavy demand, as, for example, in the cultivation of the coconut palm.

Additional Requirements

In addition to climate and soil, various other factors such as topography, location, and availability of labor should have fullest attention in considering the establishment of oil palm plantations. Because of the large quantities of fruit bunches to be transported from the field to the mill (17 to 24 tons of bunches per hectare per year) and the extensive system of roads required, the topography of the land should be as level as possible. The site of the factory is also highly important. A compromise should be made between the distance the bunches have to be hauled to the factory and the distance to which the final product has to be dispatched for shipment. Moreover, the factory should be located near an abundant supply of suitable water and should be erected on flat and reasonably high ground, i.e., above any known flood level.

VII POSSIBILITIES OF OIL PALM CULTIVATION IN THE PHILIPPINES

Environmental Factors

From Section VI it can be concluded that the chief factors in the successful development of an oil palm plantation are climate, soil, and location. It should be added that the processing of the fruit bunches requires a complicated and expensive factory; to spread the overhead costs over a sufficiently large tonnage of produce, the minimum size of an oil palm plantation must be about 1,000 or 1,500 hectares. Clearly, the oil palm is not for the small landholder as an individual.

On the basis of the climatic requirements it can be concluded that the Philippine Islands from the equator to 10°-12° N. Lat. are suitable for oil palm cultivation, provided that the annual rainfall is more or less evenly distributed and amounts to at least 2,000 mm (80 inches). The southern part of the Philippine Archipelago up to 8° N. Lat. is nearly free from typhoons; about 8 percent of the more serious typhoons affecting the Archipelago occur in the belt from 8°-11° N. Lat.; and between 11°-13° N. Lat., typhoons are quite frequent and often destructive. It is evident that the areas suitable for oil palm cultivation from a latitude point of view are situated outside the typhoon belt.

Since the present study was undertaken on behalf of the Mindanao Development Authority (MDA), and the MDA's sphere of activities relate to Mindanao, the Sulu Archipelago, and Palawan, these areas only are considered as regards their potentialities for palm oil production.

The climate map of the Philippines* shows four types of climate prevailing throughout the islands. The climate types are based on the presence or absence of a dry season and of a maximum-rainfall period. These are discussed below in relation to the area under study.

A large portion of Mindanao in the east belongs to the second type of climate, i.e., no dry season with a very pronounced maximum rainfall from November to January. The rest of the island, most of central, eastern, and southern Mindanao with the exception of the Zamboanga Peninsula and an area in the north, has the fourth type of climate, i.e., rainfall more or less evenly distributed throughout the year. The Zamboanga Peninsula and the northern area mentioned above have the third type of climate with seasons not very pronounced and a relatively dry period from November to April.

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* This map is shown in The Climate of the Philippines, a pamphlet prepared by the Climatological Division, Weather Bureau, Manila.

The Sulu Archipelago has the fourth type of climate with an evenly distributed rainfall pattern. The western part of Palawan has the first type of climate, i.e., two pronounced seasons (as in Manila): dry from November to April, wet during the rest of the year. The eastern part of Palawan belongs to the third type of climate.

For the annual rainfall by far the majority of the large number of stations located in Mindanao record annual quantities of rain in the order of 2,000 mm (80 inches) or considerably higher.*

For the Sulu Archipelago, there is only one station, located in Jolo Town, which records a long yearly mean of 80.64 inches. Palawan Island has only two stations: Brooke's Point and Puerto Princesa with annual rainfalls of 62.01 and 63.28 inches, respectively.

Having in mind the climatic requirements for the oil palm (evenly distributed rainfall of at least 80 inches) it is evident that of the areas under discussion only the greater part of Mindanao and the Sulu Archipelago appear to be suitable.

In conformity with the contract arrangements, this study deals only with the Sulu Archipelago. The Palawan area is discussed in a separate report.**

The author is quite certain, however, that in studying the possibilities for oil palm in the Philippines, the island of Mindanao should not be excluded. It is hoped that the general and detailed information contained in this report may also be utilized in considering development of the oil palm in Mindanao, which on the basis of environmental and

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* Estimates are according to Weather Bureau publications; Monthly Average Rainfall and Rainy Days in the Philippines and Annual Climatological Review for 1959, Climatological Division, Weather Bureau, Manila.

** See J. Werkhoven, Agricultural Development in The Philippines with Special Reference to Palawan, Stanford Research Institute, January 1965.

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On the basis of the climatic requirements it can be concluded that the Philippine Islands from the equator to 10°-12° N. Lat. are suitable for oil palm cultivation, provided that the annual rainfall is more or less evenly distributed and amounts to at least 2,000 mm (80 inches). The southern part of the Philippine Archipelago up to 8° N. Lat. is nearly free from typhoons; about 8 percent of the more serious typhoons affecting the Archipelago occur in the belt from 8°-11° N. Lat.; and between 11°-13° N. Lat., typhoons are quite frequent and often destructive. It is evident that the areas suitable for oil palm cultivation from a latitude point of view are situated outside the typhoon belt.

Since the present study was undertaken on behalf of the Mindanao Development Authority (MDA), and the MDA's sphere of activities relate to Mindanao, the Sulu Archipelago, and Palawan, these areas only are considered as regards their potentialities for palm oil production.

The climate map of the Philippines* shows four types of climate prevailing throughout the islands. The climate types are based on the presence or absence of a dry season and of a maximum-rainfall period. These are discussed below in relation to the area under study.

A large portion of Mindanao in the east belongs to the second type of climate, i.e., no dry season with a very pronounced maximum rainfall from November to January. The rest of the island, most of central, economic factors seems to have more advantages and opportunities than the area under study.

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* This map is shown in The Climate of the Philippines, a pamphlet prepared by the Climatological Division, Weather Bureau, Manila.

As mentioned previously, the first commercial oil palm plantation is located on Basilan Island, but it operates on a small scale. The growing conditions there are not altogether normal, since the young palms are planted under old coconut palms, and the quality of the soil needs to be improved through fertilization.

Sulu Archipelago

Of all the islands composing the Sulu Archipelago only the larger ones are considered to have economic possibilities for oil palms, viz., Tawitawi and Jolo. Siasi and other smaller islands do not have sufficiently large acreage available and can therefore be ruled out as possibilities. Siasi also has a deficient rainfall, for example, an annual average of only 53 inches during 1961-63. For the other islands, with the exception of Jolo, no rainfall data are available.

Tawitawi Island

Tawitawi is mountainous and hilly along its entire length, which limits the areas of flat-to-undulating lands required for large-scale oil palm operations. Time allocated for the study did not permit an agricultural survey to investigate the possibilities of the lands for agricultural development, and aerial-survey data are not available. As a result, recommendations cannot be made regarding the specific agricultural development of Tawitawi or its potential for certain tropical crops.

Only brief visits were made to the coconut and rubber plantation being developed by Plantation Managers' Corporation in the western part of the island (with intercropping of cacao and black pepper) and to the Tarawakan Agricultural School. A thorough field survey of Tawitawi by a team of experts (agronomists, a soil expert, forestry and husbandry men, an economist, and a community development expert) would take a long time; an aerial survey also would be necessary. In particular the Dungun River Valley deserves full attention. From the air it was observed that this valley comprises vast tracks of flat land, still partly covered with forest; also, comments received from people familiar with Tawitawi, including the manager of the NARRA Settlement, point to the importance of this valley.

A complete survey, as mentioned above, should include an intensive study of the soil factor. Most soils quite certainly will rapidly lose their fertility after the clearing of the forest, expecially on sloping lands, as could be observed at the Tarawakan Agricultural School among others, where the topsoil had been eroded and a red sticky subsoil remained. Such a soil provides a poor environment for the growing of crops, so that yields of palay and other crops have been very disappointing. On the flatter areas the loss of topsoil, organic matter, and nutrients is less serious, as observed on the plantation being developed by the Plantation Managers' Corporation where, moreover, the soil is covered by excellently growing leguminous covers.

Since unfortunately no rainfall data are available for any part of Tawitawi, little can be said at the moment about the future yield levels of rubber, oil palm, and other permanent crops. It may be anticipated, however, that rubber can be grown favorably in many parts of Tawitawi. Even if the soils and other factors in the Dungun Valley were to prove suitable, the establishment of an oil palm plantation, involving such a heavy investment, is considered too great a risk so long as no reliable climatic data are available. However, there is no question that a modern oil palm plantation would be an enormous stimulus to the development of such a frontier area.

It may be restated that during the agricultural development of Tawitawi, due attention must be paid to soil conservation. This is necessary to avoid the serious loss of soil fertility which occurred in so many areas by kaingin farming and other destructive agricultural practices, and which ultimately resulted in the vast tracks of poor lands and extensive cogonals. In this respect the advantages of cultivating such permanent crops as rubber and oil palm are obvious.

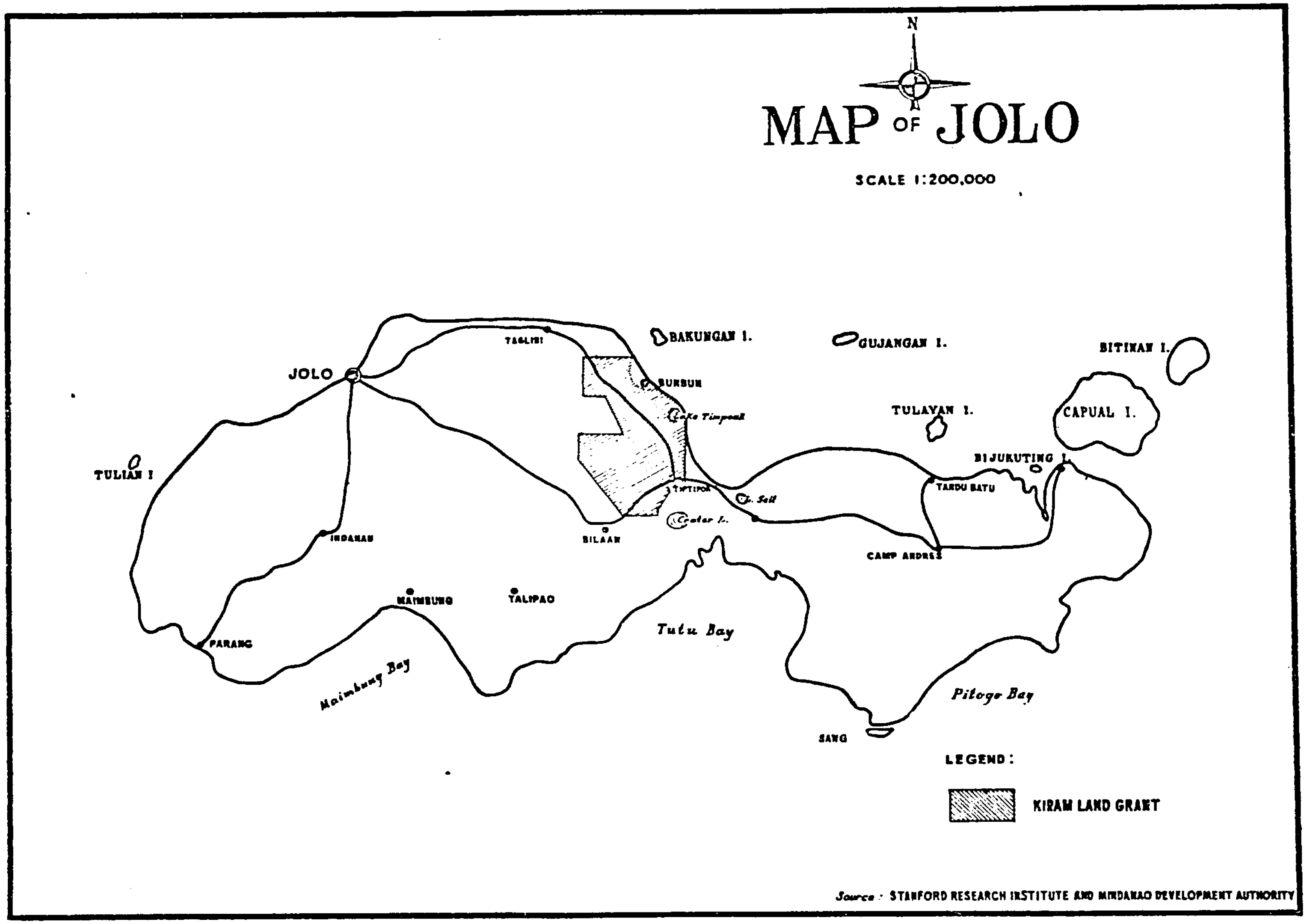
Jolo Island

The island of Jolo is mountainous and hilly in general, but most of the slopes are suited to and a great many are indeed used for the cultivation of a variety of crops. Since economic oil palm cultivation requires more or less flat land covering an area of at least 1,000 hectares, this study was directed only to areas meeting those conditions.

Most of the flatter lands of Jolo are already occupied and under cultivation, and the only area to be considered appeared to be the Kiram Land Grant. In this property, approximately 4,000 hectares of relatively flat land are available for large-scale plantation operations.

Also in the Tandu Batu area of Jolo Island there is still land available (some 800 hectares); this flat area with its good soils should have special attention in further planning.

As the Kiram property covers the largest area of flat-to-slightly undulating land, the following discussions on the possibilities for palm oil production in Jolo refer to that area exclusively.



MAP OF JOLO

SCALE 1:200,000

Source: STANFORD RESEARCH INSTITUTE AND MINDANAO DEVELOPMENT AUTHORITY

VIII THE KIRAM LAND GRANT AND ITS SUITABILITY FOR OIL PALMS

The Kiram Land Grant, located at 6° N. Lat. and 121°10' E. Long, lies in the barrio Tiptipon, municipal districts of Panamau and Talipau. It is about 28 km from Jolo Town, with which it is connected by a good road. A second road leading from Tiptipon to the north and transversing the property goes via Patikul to Jolo Town and is mainly a secondary road. Both roads meet at a junction lying inside the property. At present there are no feeder roads within the property.

The agricultural suitability of the Kiram property for oil palm cultivation has been considered from the standpoint of climate, soil, and elevation.

Climate

Rainfall

The climate is of the fourth type, so the rainfall is fairly evenly distributed throughout the year. Since weather is recorded only in Jolo Town, most discussions on rainfall under Tiptipon conditions have been based on the records of that station.

According to the Jolo data the drier months are January through March when monthly rainfall averages about 100 mm, which compares with 172-225 mm monthly during the remaining period. October has the highest recorded average (8.91 inches) and highest number of rainy days (17), and January has the lowest rainfall (4.12 inches) and 9 rainy days.* Table 7 provides climatic data on rainfall, rainy days, relative humidity, and temperature.

The long yearly mean of Jolo shows a favorable rainfall of some 2,000 mm (80 inches), but it is noted that occasionally dry to very dry years occur. In this respect the variability in annual rainfall and in the number of rainy days as shown in Tables 8 and 9 for the years 1954-63 is notable. Table 8 shows that in the last decennium there were four years

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* These averages were calculated from data recorded over a 57-year period and reported in 1962 by the Weather Bureau, Manila.

Table 7

WEATHER DATA RECORDED AT THE JOLO TOWN WEATHER STATION
(06°03' N. Lat, 121° E. Long.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Years of Record
Rainfall, inches	4.12	4.18	4.22	5.63	8.55	8.78	7.02	6.70	7.40	8.91	8.47	6.66	80.64	57
Rainy days[a]	9	8	9	11	16	17	15	14	15	17	17	14	162	Long yearly mean
Relative humidity, percent	86%	87%	87%	86%	87%	86%	85%	84%	85%	86%	86%	86%	86%	Long yearly mean
Temperature, °C	26.2	26.0	26.3	26.7	27.0	26.9	26.9	27.0	26.9	26.6	26.5	26.4	26.6	29

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[a] A rainy day is defined as a day with 0.01 inch or more of rain.

Source: Weather Bureau, Manila.

Table 8

MONTHLY RAINFALL RECORDED AT THE JOLO TOWN WEATHER STATION
1954-1963
(Inches)

Month	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
January	1.04	3.66	4.03	2.65	0.72	2.34	2.89	2.63	4.73	9.68
February	7.91	1.16	3.77	0.70	3.33	2.39	6.33	0.72	3.02	1.98
March	6.23	5.30	5.50	0.78	0.32	6.82	5.70	1.06	11.38	1.79
April	5.95	7.03	6.65	6.23	1.96	4.21	6.20	9.61	7.49	2.92
May	3.43	5.03	15.71	10.09	5.60	13.43	11.32	8.09	12.72	7.96
June	9.12	10.93	12.34	12.27	5.71	15.87	13.14	7.57	6.77	4.72
July	8.29	15.88	7.42	7.45	5.80	17.95	15.07	3.42	2.69	2.65
August	7.11	7.77	5.79	7.09	7.64	4.52	3.42	1.74	3.57	7.74
September	12.12	11.23	9.91	2.83	4.16	10.42	6.25	11.60	6.30	3.15
October	14.09	11.82	13.74	5.23	15.47	13.89	7.20	5.75	7.34	6.97
November	9.95	15.94	13.14	5.75	8.27	3.54	8.31	6.17	8.99	3.45
December	3.82	10.30	11.12	2.48	4.38	6.64	1.03	3.11	13.37	4.72
Annual	89.06	106.05	109.12	63.55	63.36	102.02	86.86	61.47	88.37	57.73

Source: Weather Bureau, Manila.

Table 9

NUMBER OF RAINY DAYS RECORDED AT THE JOLO TOWN WEATHER STATION
1954-1963

Month	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
January	10	16	13	9	4	3	9	3	16	13
February	9	8	6	4	6	10	8	5	7	11
March	11	9	12	6	3	10	11	6	18	6
April	14	11	16	11	8	5	9	14	12	2
May	15	15	23	21	13	20	17	13	16	15
June	24	22	23	13	12	24	16	16	14	7
July	21	24	13	15	11	20	20	13	11	11
August	14	23	14	10	15	12	11	10	17	17
September	19	18	14	10	10	16	19	19	17	7
October	19	21	20	13	24	19	18	15	15	16
November	21	24	22	11	17	16	16	13	19	14
December	12	16	18	6	15	13	14	9	23	11
Annual	189	207	194	129	138	168	168	136	185	130

Source: Weather Bureau, Manila.

with less than 70 inches (about 1,750 mm) and that 1963 was a particularly dry year (57.73 inches). Dry years have occurred since 1957, which is in accordance with recent climate reports from many other southern islands in the Philippines and is often ascribed to a change in climate in general. These dry years do not present optimal growing conditions for such crops as oil palm, rubber, banana, abaca, and coconut palms. In such drier years, the normally drier months (January, February, and March) usually become even drier so that drought periods for field crops may occur.

In general, however, the rainfall distribution recorded in Jolo does not show so-called "dry months," i.e., months with a rainfall lower than 50-60 mm.

It may be restated that all these data refer to Jolo Town, and it remains to be determined whether the Tiptipon area, where no weather data are collected, has the same rainfall pattern.

Since the rain factor has such a tremendous effect on oil palm yields and consequently on the economic aspects of oil palm cultivation, the author took great pains to be informed on the rainfall conditions on the Kiram property. Although, as was to be expected, no reliable and accurate data could be obtained, the concensus of opinion was that the Tiptipon area is somewhat less wet than Jolo Town. In this respect, it is to be noted that according to an analysis of the rainfall distribution worked out by the Weather Bureau in 1959, the west of Jolo had 80 inches of rain and the east, 70 inches.

To arrive at estimates of future oil palm yields in the Tiptipon area, a decision had to be made on the rainfall factor. After ample consideration it was concluded that 70 inches of rain annually is a reasonable working basis for discussions and calculations concerning palm oil production in the Tiptipon area of Jolo. It was also noted that most rain in the area apparently comes down in heavy showers, so that not all the precipitation can be utilized efficiently by the growing crop. However, in this study the rainfall conditions in the area are regarded as suitable but not optimal for the growing of the oil palm.

Concerning the rainfall data of Jolo Town, it is important to note that the measurement of rain is not conducted in the standard way. Instead of the standard metal stick a nonstandard wooden stick of somewhat larger thickness and width is used, which results in figures that are too high (by perhaps 5 percent or more). According to the Weather Bureau, nonstandard sticks are also in use on Basilan Island.

In October 1964 the Bureau took measures for correction. How long the nonstandard sticks have been used is not known. If the rainfall data in Jolo were collected incorrectly during the entire period of record, then the basis of rainfall assumed for Tiptipon conditions cannot be put higher than 70 inches.

Temperature

The monthly average temperature at Jolo ranges from 26° to 27°C, resulting in a yearly mean of 26.6°C (Table 7). The temperature at Tiptipon is therefore to be considered suitable for a favorable growth of oil palms.

Humidity

The monthly figures range from 84 to 86 percent; the yearly mean is 86 percent, which is good for oil palms.

Sunshine Hours

No data on sunshine hours are available; many Jolo people agree that the sunshine requirement of the oil palm, i.e., at least five or six hours of sunshine a day, is certainly met on Jolo Island. This factor is of great importance in oil production and should have due attention. Since subjective information cannot be relied on, recording of sunshine is considered necessary.

Evaporation

There are no records for Jolo and Tiptipon.

Wind

No strong winds are prevalent in the area; the island is outside the typhoon belt.

Soil

The lands of Jolo and particularly the lands of the Kiram property have been cleared from forest for so long that much of the original high fertility of the soil has disappeared.

The soils formed in situ (residual soils) originate from igneous rocks (basalts and andesites). The soils of the Kiram property are generally of a clay-loam texture and exceptionally deep. Soil sampling showed no clear limits as to the horizons, and quite often the clayey texture increased with depth. Nowhere, even at depths of 2 meters, could underlying rock be detected, and neither impervious layers nor a water-table were encountered. Only in certain parts of the property were stones found, both on the surface and in the soil.

The soils under review are classified by the Bureau of Soils as the Tiptipon series. A full description quoted from the report (No. 35)* on the soil survey of Sulu Porvince is given in Appendix A.

No reliable data could be obtained about the cropping capability of the Tiptipon soils. According to the Project Study Report for the Kiram Abaca Development Project, 1963, abaca yields in the area were reported to amount to only 12 piculs per hectare per year, which is quite low. In many areas cropping is mostly done under such poor husbandry that the actual yields remain far below the potential yields. The low yields usually obtained are in no case good measurements of the fertility of the soil. Unfortunately the results of analysis of the soil samples taken during the author's survey of the Kiram lands, and to be analyzed by the Royal Tropical Institute in Amsterdam, are not yet available.**

Anticipating these results the soil is considered suited to the growing of oil palms. Soil conditions are positively not optimal; a loamy soil with sufficient humus would be preferable. Since, however, the Tiptipon soil is claimed to drain fairly well, a good growth of the palms is to be expected. In the areas with more clayey subsoil, drainage may be too slow. On the basis of field observations, it is feared that not only the clay content but also the silt content may be very high, which could result in drainage difficulties. At present nothing is known about the acidity of the soil and the availability of minor nutrient elements. However, the nutritional status of the soil could be better, and the amount of organic matter also is quite probably not up to standard. The impoverishment of the soil is due to former kaingin cultivation, deforestation, deterioration of the spontaneous vegetation, and fires resulting in the present sheet cogon vegetation, which covers nearly the whole property.

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* Confidentially put at the disposal of the author by the Bureau of Soils in Manila.

** The soil analysis results will be submitted as a supplement to the report.

The conversion of the noxious cogon cover into a leguminous one is urgent. The establishment of an active leguminous cover, maintained properly to give cogon no new chances and to improve the organic matter status of the soil, and the timely, regular, and adequate application of fertilizers are considered essential measures for favorable development and good yields of the oil palms.

Elevation

The lands under review are suitable for oil palm as they are within the economic limit of 500-600 meters above sea level.

Conclusion

Although many uncertainties exist, it is to be concluded that on the basis of the factors discussed above--climate, soil, and elevation--the Kiram Land Property from an agricultural point of view is suitable for the growing of oil palms. However, the conditions are not considered the best that might be found in tropical areas suitable for palm oil, since both rainfall and soil quality are not optimal as far as can be assumed on the basis of the limited data now available. Additional information regarding rainfall and soil quality is needed for testing these conclusions.

IX THE ECONOMIC FEASIBILITY OF AN OIL PALM PLANTATION UNDER THE CONDITIONS OF THE KIRAM LAND GRANT

The Kiram Land Grant as the Proposed Site

Apart from the primary agricultural requirements the following factors should be considered.

Topography, Location, and Size

The topography of the land ranges from nearly level and slightly undulating up to rolling with hills on the boundary of the property. From the hills the land gradually slopes down toward the shoreline in the northeastern portion of the property.

From a total of nearly 4,100 hectares available on the Kiram Land Grant some 1,500 hectares were selected as having the best conditions for an oil palm plantation from the standpoint of elevation, levelness, general slope, layout of roads, compactness, and factory site.

A future detailed technical survey, particularly regarding topography and location, may show that expansion to 2,000 hectares or even more is feasible and practical.

Considering the general slope of the lands, the best place for the palm oil factory would be in the northeastern part near the coast.

Transportation

As mentioned earlier, the property is connected with Jolo Town by a good road, so that transport of materials from and delivery of produce to Jolo harbor, with its good docking facilities, is secured throughout the year.

The construction of a wharf on the shoreline in the northeastern part of the property is worth considering.*

There is an excellent air service by the Philippine Air Lines (PAL) between Jolo and Manila via Zamboanga.

Labor

The initial source of labor is the 300 families who are now tenants on the property, and in addition, there are people available from surrounding barrios and municipalities. A plantation in full operation needs about 0.33 men per hectare, of which 10 percent are skilled personnel.

Source of Water

A source of potable and industrial water is a spring in the northeastern part of the property near the shore. The best place for the factory would, of course, be near this spring.

Another good water source is a lake, also situated in the northeastern part of the property near the coast.

Peace and Order

It is generally recognized that the condition of peace and order on Jolo Island leaves much to be desired. It may be assumed, however, that a large flourishing agricultural industry in the center of the island will have a favorable effect on the overall economy by providing work, security, and income to many hundreds of people, and by contributing to and stimulating considerably the overall development of this island.

The cost of wharf facilities has been included in cost calculations for the proposed oil palm plantation later in this section.

Economic Factors in General

The basis for the following discussions and calculations concerning an oil palm estate on the Kiram Land Grant is an area of 1,500 hectares.

The principal factors to be taken into consideration in estimating the possible returns from the cultivation of oil palms on a plantation scale are in general the following:

1. The capital cost of bringing the plantation into full bearing
2. The average yield of palm oil and palm kernels per hectare per year
3. The total cost of production
4. The selling price of the palm oil and palm kernels

Calculations of Investment Costs

The following working estimates are used for calculating the capital investment cost of an oil palm plantation on the Kiram property.

1. Fifteen hundred hectares planted in DP* material yielding at full maturity 17.5 tons of bunches at 20 percent oil extraction, or 3.5 tons of palm oil annually; and
2. A planting program as follows: first year, 150 hectares; second year, 250 hectares; third year, 500 hectares; fourth year, 600 hectares.

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* DP = dura x pisifera cross, which gives 100% thin-shelled tenera palms.

The schedule assumed for planting and harvesting for a 1,500-hectare plantation, 1966-1974, is given below, the hectares planted each year being equal to the number prepared.

Purchase of seed, establishment of nursery	Early 1966
Field preparation, 150 hectares	Early 1967
First planting	Mid 1967
Field preparation, 250 hectares	Early 1968
Second planting	Mid 1968
Field preparation, 500 hectares	Early 1969
Third planting	Mid 1969
Field preparation, 600 hectares	Early 1970
Fourth planting	Mid 1970
First harvest, 1967 planting	1971
First harvest, 1968 planting	1972
First harvest, 1969 planting	1973
First harvest, 1970 planting	1974

From 1974 on, the entire plantation of 1,500 hectares is in production, the crop being harvested continually throughout the year.

Production of Planting Material (1.5 Years). Financial requirements for the production of planting material prior to the establishment of the plantation are given in Table 10. These figures are for a nursery of one hectare, which is sufficient for 50 hectares of plantation, planted with 143 palms to the hectare (9 X 9 meters, triangular).

Field Costs. Table 11 provides details of the man-days and costs for clearing, planting, and maintenance up to the first harvest of one hectare of plantation under Tiptipon conditions. The table shows that the field charges for one hectare of oil palm plantation up to maturity amount to ₱2,080.

Table 10

ESTIMATED MATERIALS AND LABOR COSTS FOR ONE HECTARE OF NURSERY

		Cost (pesos)	
Item	Number	Nursery	Per Hectare of Plantation
Seed			
300 seeds per hectare to be planted @ ₱0.80 (US$0.20)	15,000	₱12,000	₱240
Germination losses, 30%	-4,500		
Prenursery losses, 15%	-1,600		
Nursery losses including selection, 16%	-1,400		
Total available: 7,150 + 5% for supplies	7,500		
7,500/50 = 150 per hectare of plantation = 143 palms + 5% for supplies per hectare			
Other materials			
Fertilizers, pesticides, and others (sand, lumber, etc.)		400	
Labor in man-days,[a] required for prenursery and nursery periods			
Field preparation	250		
Establishment	100		
Lining	25		
Sowing seeds and planting seedlings	75		
Upkeep	550		
Mulching	175		
Fertilizing	50		
Watering	50		
Control of pests and diseases, and provision for contingencies	125		
Total man-days @ ₱4 per day	1,400	5,600	112
Total estimated nursery cost		₱18,000	₱360

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[a] Here and throughout the study the wage per day for an unskilled agricultural laborer is ₱4.

Source: Stanford Research Institute.

Table 11

ESTIMATED COST PER HECTARE FOR CLEARING, PLANTING, AND UPKEEP TO MATURITY OF AN OIL PALM PLANTATION, JOLO[a]

Item	First Year			Second Year			Third Year			Fourth Year			Total
	Labor[b]		Nonlabor[c]	Labor[b]		Nonlabor[c]	Labor[b]		Nonlabor[c]	Labor[b]		Nonlabor[c]	
Borders	(1)	₱ 4	₱ --		₱ --	₱--		₱ --	₱--		₱ --	₱--	₱ 4
Clearing													
Two plowings		--	125		--	--		--	--		--	--	125
Two harrowings		--	50		--	--		--	--		--	--	50
Road construction	(4)	16	--		--	--		--	--		--	--	16
Tractor cost and materials		--	112		--	--		--	--		--	--	112
Road maintenance		--	--	(4)	16	--	(4)	16	--	(4)	16	--	48
Tractor cost and materials		--	--		--	4		--	4		--	4	12
Bridges		--	30		--	--		--	--		--	--	30
Lining	(4)	16	--		--	--		--	--		--	--	16
Holing	(5)	20	--		--	--		--	--		--	--	20
Fertilizing holes	(3)	12	--		--	--		--	--		--	--	12
Fertilizer		--	8		--	--		--	--		--	--	8
Initial weeding	(6)	24	--		--	--		--	--		--	--	24
Planting material		--	360		--	--		--	--		--	--	360
Lifting, transport	(6)	24	--		--	--		--	--		--	--	24
Planting	(5)	20	--		--	--		--	--		--	--	20
Sowing ground covers	(4)	16	--		--	--		--	--		--	--	16
Seeds and fertilizer		--	29		--	--		--	--		--	--	29
Antierosion measures	(4)	16	--		--	--		--	--		--	--	16
Drainage	(1)	4	--		--	--		--	--		--	--	4
Supplying	(0.5)	2	--		--	--		--	--		--	--	2
Fertilizing palms	(2.5)	10	--	(6)	24	--	(8)	32	--	(6)	24	--	90
Fertilizer		--	11		--	28		--	73		--	54	166
Fertilizing ground cover	(2)	8	--		--	--		--	--		--	--	8
Fertilizer		--	44		--	--		--	--		--	--	44
Control of pests and diseases	(2)	8	--	(2)	8	--	(2)	8	--	(2)	8	--	32
Pesticides		--	24		--	10		--	10		--	10	54
Weeding	(53)	212	--	(60)	240	--	(33)	132	--	(30)	120	--	704
Harvesting paths		--	--		--	--		--	--	(2)	8	--	8
First pruning		--	--		--	--		--	--	(2.5)	10	--	10
Miscellaneous		--	--		--	--		--	--	(4)	16	--	16
Subtotals	(103)	₱412	₱793	(72)	₱288	₱42	(47)	₱188	₱87	(50.5)	₱202	₱68	
Total per hectare		₱1,205			₱330			₱275			₱270		₱2,080

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a. Commercial production starts 3.5 years after field planting.
b. Parenthetical numbers are man-days required @ ₱4.
c. Includes materials and supplies.

Source: Stanford Research Institute.

Yields and Production

It is most difficult to foresee the yield of a new crop to be introduced under conditions not fully known and from seeds of rather unknown potential yield. The importance of adequate and evenly distributed rainfall has already been stressed. Unfortunately, no sufficiently reliable data are available.

Other questions to be answered are:

1. What is the production potential of the planting material to be purchased abroad?
2. What will be the actual yield, in bunches and oil, of such material under the given conditions? In particular, the oil-to-bunch ratio is highly important. The teneras must have a favorable bunch and fruit composition.

For making calculations, the DP planting material in question is assumed to be high yielding up to a level of 5 tons per hectare per year under favorable conditions. Note in this connection that the yielding capacity of modern tenera material may be rather variable. The author estimates that the superior planting material mentioned above will produce 3.5 tons of palm oil per hectare per year at full maturity, under the conditions of the Kiram property and assuming a 70-inch rainfall.

Deficient rainfall can be made good to a certain extent by a soil with favorable water capacity. However, it is anticipated that the soil analysis will show that the soils concerned, although clayey, have a rather poor organic matter status. In drier periods of drier years such as 1963, therefore, soil moisture supply to growing crops may be deficient, which adversely affects the yields. If the rainfall in the Tiptipon area is in fact higher than the data indicated, attaining an average of 80 inches, and the soil proves to be up to standard, the yield estimate would be raised to 4.5 tons of palm oil per hectare per year.

The significant effect of growing conditions on the level of yields and, consequently, on the profits derived from the cultivation of the oil palm hardly needs to be emphasized.

Under favorable conditions, the oil palm will start to yield 2.5 years after field planting, but commercial harvesting usually begins after about 3.5 years. The first harvests are small but increase considerably in the course of years.

The estimated yields during the lifetime of a plantation laid down from DP planting material is given in Table 12 for three cases: (1) optimal conditions of environment and planting material; (2) Jolo (i.e., Tiptipon) conditions with 70-inch rainfall; and (3) conditions in Jolo with 80-inch rainfall and a more favorable soil factor (in other words, the Kiram Land Grant if it had 80 inches of rain and better soil).

Using the yield figures of Table 12, the production of oil and kernels for a 1,500-hectare plantation (Case I below) with 70 inches of rain has been calculated for the entire period of commercial productivity of the plantation (25 productive years after 3.5 nonproductive years). These production figures for bunches and kernels are given in Tables 13 and 14, respectively.

In addition to Case I and for purposes of comparison, the annual yield figures* throughout the lifetime of a plantation for five other cases (II-VI) are considered as follows:

I. Jolo Conditions, 70 inches of rain (Tables 13 and 14). A plantation of 1,500 hectares yielding at full maturity 17.5 tons of bunches at 20 percent oil extraction will yield 3.5 tons of palm oil per hectare per year plus 0.74 tons of kernels per hectare per year (4.2 percent).

II. Jolo Conditions, 70 inches of rain (Tables 15 and 16). A plantation of 1,000 hectares yielding at full maturity 17.5 tons of bunches at 20 percent oil extraction will yield 3.5 tons of palm oil per hectare per year plus 0.74 tons of kernels per hectare per year (4.2 percent).

III. Jolo Conditions, 80 inches of rain (Tables 17 and 18). A plantation of 1,500 hectares yielding at full maturity 21 tons of bunches at 21.5 percent oil extraction will yield 4.5 tons of palm oil per hectare per year plus 0.88 tons of kernels per hectare per year (4.2 percent).

IV. Jolo Conditions, 80 inches of rain (Tables 19 and 20). A plantation of 1,000 hectares yielding at full maturity 21 tons of bunches at 21.5 percent oil extraction will yield 4.5 tons of palm oil per hectare per year plus 0.88 tons of kernels per hectare per year (4.2 percent).

Throughout this study the oil-to-bunch ratio used is the extraction rate of oil obtained in the factory.

Table 12

ESTIMATED OIL PALM YIELDS UNDER DIFFERENT GROWING CONDITIONS OVER A 25-YEAR PERIOD[a]

(Tons per Hectare)

Year of Production	Optimal Conditions				Conditions--Jolo (70-inch rainfall)				Conditions--Jolo (80-inch rainfall)			
	Bunches	Extraction (percent)	Oil	Kernels	Bunches	Extraction (percent)	Oil	Kernels	Bunches	Extraction (percent)	Oil	Kernels
First	5	10 %	0.5	0.20	2	8 %	0.16	0.08	4	10 %	0.4	0.17
Second	10	12	1.2	0.40	5	10.5	0.53	0.21	8	12	1.0	0.34
Third	15	14	2.1	0.60	8	12.5	1.0	0.33	11	14	1.5	0.46
Fourth	18	17	3.1	0.72	10	15	1.5	0.42	13	17	2.2	0.55
Fifth	21	18	3.8	0.84	12	16	1.9	0.50	15	18.5	2.8	0.63
Sixth	22.	19.5	4.4	0.90	13.5	18	2.4	0.57	17	19.5	3.3	0.72
Seventh	24	20.5	4.9	0.96	15.5	19	3.0	0.65	19	20	3.8	0.80
Eighth	24	21.5	5.2	0.96	16.5	19.5	3.2	0.69	21	20.5	4.3	0.88
Ninth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Tenth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Eleventh	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Twelfth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Thirteenth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Fourteenth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Fifteenth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Sixteenth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Seventeenth	24	21.5	5.2	0.96	17.5	20	3.5	0.74	21	21.5	4.5	0.88
Eighteenth	23	21	4.8	0.92	17	20	3.4	0.71	20	21	4.2	0.84
Nineteenth	23	21	4.8	0.92	17	20	3.4	0.71	20	21	4.2	0.84
Twentieth	22	21	4.6	0.88	17	20	3.4	0.71	20	21	4.2	0.84
Twenty-first	22	21	4.6	0.88	17	20	3.4	0.71	19	20	3.8	0.80
Twenty-second	21	21	4.4	0.84	17	20	3.4	0.71	19	20	3.8	0.80
Twenty-third	21	21	4.4	0.84	16	19.5	3.1	0.67	19	20	3.8	0.80
Twenty-fourth	20	20	4.0	0.80	16	19.5	3.1	0.67	18	20	3.6	0.76
Twenty-fifth	20	20	4.0	0.80	16	19.5	3.1	0.67	18	20	3.6	0.76

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a. Commercial production starts 3.5 years after field planting.

Source: Stanford Research Institute.

Table 13

PALM OIL PRODUCTION ON A 1,500-HECTARE OIL PALM PLANTATION UNDER JOLO CONDITIONS WITH A 70-INCH ANNUAL RAINFALL[a]

1971-1995

(Tons)

	Bunches									Palm Oil				
Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output	1967	1968	1969	1970	Total Output
1971	150 x 2 =	300	250 x 0 =	0	500 x 0 =	0	600 x 0 =	0	300	25	0	0	0	25
1972	5	750	2	500	0	0	0	0	1,250	85	40	0	0	125
1973	8	1,200	5	1,250	2	1,000	0	0	3,450	150	140	80	0	370
1974	10	1,500	8	2,000	5	2,500	2	1,200	7,200	225	250	275	100	850
1975	12	1,800	10	2,500	8	4,000	5	3,000	11,300	285	375	500	330	1,490
1976	13.5	2,025	12	3,000	10	5,000	8	4,800	14,825	360	475	750	600	2,185
1977	15.5	2,325	13.5	3,375	12	6,000	10	6,000	17,700	450	600	950	900	2,900
1978	16.5	2,475	15.5	3,875	13.5	6,750	12	7,200	20,300	480	750	1,200	1,140	3,570
1979	17.5	2,625	16.5	4,125	15.5	7,750	13.5	8,100	22,600	525	800	1,500	1,440	4,265
1980	17.5	2,625	17.5	4,375	16.5	8,250	15.5	9,300	24,550	525	875	1,600	1,800	4,800
1981	17.5	2,625	17.5	4,375	17.5	8,750	16.5	9,900	25,650	525	875	1,750	1,920	5,070
1982	17.5	2,625	17.5	4,375	17.5	8,750	17.5	10,500	26,250	525	875	1,750	2,100	5,250
1983	17.5	2,625	17.5	4,375	17.5	8,750	17.5	10,500	26,250	525	875	1,750	2,100	5,250
1984	17.5	2,625	17.5	4,375	17.5	8,750	17.5	10,500	26,250	525	875	1,750	2,100	5,250
1985	17.5	2,625	17.5	4,375	17.5	8,750	17.5	10,500	26,250	525	875	1,750	2,100	5,250
1986	17.5	2,625	17.5	4,375	17.5	8,750	17.5	10,500	26,250	525	875	1,750	2,100	5,250
1987	17.5	2,625	17.5	4,375	17.5	8,750	17.5	10,500	26,250	525	875	1,750	2,100	5,250
1988	17	2,550	17.5	4,375	17.5	8,750	17.5	10,500	26,250	525	875	1,750	2,100	5,250
1989	17	2,550	17	4,250	17.5	8,750	17.5	10,500	26,175	510	875	1,750	2,100	5,235
1990	17	2,550	17	4,250	17	8,500	17.5	10,500	26,050	510	850	1,750	2,100	5,210
1991	17	2,550	17	4,250	17	8,509	17.5	10,500	25,800	510	850	1,700	2,100	5,160
1992	17	2,550	17	4,250	17	8,500	17	10,200	25,500	510	850	1,700	2,040	5,100
1993	16	2,400	17	4,250	17	8,500	17	10,200	25,500	510	850	1,700	2,040	5,100
1994	16	2,400	16	4,000	17	8,500	17	10,200	25,350	470	850	1,700	2,040	5,060
1995	16	2,400	16	4,000	16	8,000	17	10,200	25,100	470	780	1,700	2,040	4,990
									24,600	470	780	1,560	2,040	4,850
Total														97,855

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a. Annual per-hectare yield at maturity: 17.5 tons of bunches with 20 percent oil extraction, or 3.5 tons of oil, and 0.74 tons of kernels.

Source: Stanford Research Institute.

Table 14

PALM KERNEL PRODUCTION ON A 1,500-HECTARE OIL PALM PLANTATION UNDER JOLO CONDITIONS WITH A 70-INCH ANNUAL RAINFALL

1971-1995

(Tons)

Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output
1971	150 x 0.08 =	12	250 x 0 =	0	500 x 0 =	0	600 x 0 =	0	12
1972	0.21	32	0.08	20	0	0	0	0	52
1973	0.33	50	0.21	53	0.08	40	0	0	143
1974	0.42	63	0.33	83	0.21	105	0.08	48	299
1975	0.50	75	0.42	105	0.33	165	0.21	126	471
1976	0.57	86	0.50	125	0.42	210	0.33	198	619
1977	0.65	98	0.57	143	0.50	250	0.42	252	743
1978	0.69	104	0.65	163	0.57	285	0.50	300	852
1979	0.74	111	0.69	173	0.65	325	0.57	342	951
1980	0.74	111	0.74	185	0.69	345	0.65	390	1,031
1981	0.74	111	0.74	185	0.74	370	0.69	414	1,080
1982	0.74	111	0.74	185	0.74	370	0.74	444	1,110
1983	0.74	111	0.74	185	0.74	370	0.74	444	1,110
1984	0.74	111	0.74	185	0.74	370	0.74	444	1,110
1985	0.74	111	0.74	185	0.74	370	0.74	444	1,110
1986	0.74	111	0.74	185	0.74	370	0.74	444	1,110
1987	0.74	111	0.74	185	0.74	370	0.74	444	1,110
1988	0.72	108	0.74	185	0.74	370	0.74	444	1,107
1989	0.72	108	0.72	180	0.74	370	0.74	444	1,102
1990	0.72	108	0.72	180	0.72	360	0.74	444	1,092
1991	0.71	107	0.72	180	0.72	360	0.72	432	1,079
1992	0.71	107	0.71	178	0.72	360	0.72	432	1,077
1993	0.67	101	0.71	178	0.71	355	0.72	432	1,066
1994	0.67	101	0.67	168	0.71	355	0.71	426	1,050
1995	0.67	101	0.67	168	0.67	335	0.71	426	1,030
Total									21,516

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a. Annual per-hectare yield at maturity: 17.5 tons of bunches with 20 percent oil extraction, or 3.5 tons of oil, and 0.74 tons of kernels.

Source: Stanford Research Institute.

Table 15

PALM OIL PRODUCTION ON A 1,000-HECTARE OIL PALM PLANTATION UNDER JOLO CONDITIONS WITH A 70-INCH ANNUAL RAINFALL[a]

1971-1995

(Tons)

	Bunches									Palm Oil				
Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output	1967	1968	1969	1970	Total Output
1971	150 x 2 =	300	250 x 0 =	0	250 x 0 =	0	350 x 0 =	0	300	25	0	0	0	25
1972	5	750	2	500	0	0	0	0	1,250	85	40	0	0	125
1973	8	1,200	5	1,250	2	500	0	0	2,950	150	140	40	0	330
1974	10	1,500	8	2,000	5	1,250	2	700	5,450	225	250	140	55	670
1975	12	1,800	10	2,500	8	2,000	5	1,750	8,050	285	375	250	190	1,100
1976	13.5	2,025	12	3,000	10	2,500	8	2,800	10,325	360	475	375	350	1,560
1977	15.5	2,325	13.5	3,375	12	3,000	10	3,500	12,200	450	600	475	525	2,050
1978	16.5	2,475	15.5	3,875	13.5	3,375	12	4,200	13,925	480	750	600	665	2,495
1979	17.5	2,625	16.5	4,125	15.5	3,875	13.5	4,725	15,350	525	800	750	840	2,915
1980	17.5	2,625	17.5	4,375	16.5	4,125	15.5	5,425	16,550	525	875	800	1,050	3,250
1981	17.5	2,625	17.5	4,375	17.5	4,375	16.5	5,775	17,150	525	875	875	1,120	3,395
1982	17.5	2,625	17.5	4,375	17.5	4,375	17.5	6,125	17,500	525	875	875	1,225	3,500
1983	17.5	2,625	17.5	4,375	17.5	4,375	17.5	6,125	17,500	525	875	875	1,225	3,500
1984	17.5	2,625	17.5	4,375	17.5	4,375	17.5	6,125	17,500	525	875	875	1,225	3,500
1985	17.5	2,625	17.5	4,375	17.5	4,375	17.5	6,125	17,500	525	875	875	1,225	3,500
1986	17.5	2,625	17.5	4,375	17.5	4,375	17.5	6,125	17,500	525	875	875	1,225	3,500
1987	17.5	2,625	17.5	4,375	17.5	4,375	17.5	6,125	17,500	525	875	875	1,225	3,500
1988	17	2,550	17.5	4,375	17.5	4,375	17.5	6,125	17,425	510	875	875	1,225	3,485
1989	17	2,550	17	4,250	17.5	4,375	17.5	6,125	17,300	510	850	875	1,225	3,460
1990	17	2,550	17	4,250	17	4,250	17.5	6,125	17,175	510	850	850	1,225	3,435
1991	17	2,550	17	4,250	17	4,250	17	5,950	17,000	510	850	850	1,190	3,400
1992	17	2,550	17	4,250	17	4,250	17	5,950	17,000	510	850	850	1,190	3,400
1993	16	2,400	17	4,250	17	4,250	17	5,950	16,850	470	850	850	1,190	3,360
1994	16	2,400	16	4,000	17	4,250	17	5,950	16,600	470	780	850	1,190	3,290
1995	16	2,400	16	4,000	16	4,000	17	5,950	16,350	470	780	780	1,190	3,220
Total														65,965

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a. Annual per-hectare yield at maturity: **17.5 tons of bunches with 20 percent oil extraction, or 3.5 tons of oil, and 0.74 tons of kernels.**

Source: Stanford Research Institute.

Table 16

PALM KERNEL PRODUCTION ON A 1,000-HECTARE OIL PALM PLANTATION UNDER JOLO CONDITIONS WITH A 70-INCH ANNUAL RAINFALL[a]

1971-1995

(Tons)

Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output
1971	150 x 0.08 =	12	250 x 0 =	0	250 x 0 =	0	350 x 0 =	0	12
1972	0.21	32	0.08	20	0	0	0	0	52
1973	0.33	50	0.21	53	0.08	20	0	0	123
1974	0.42	63	0.33	83	0.21	53	0.08	82	227
1975	0.50	75	0.42	105	0.33	83	0.21	74	337
1976	0.57	86	0.50	125	0.42	105	0.33	116	432
1977	0.65	98	0.57	143	0.50	125	0.42	147	513
1978	0.69	104	0.65	163	0.57	143	0.50	175	585
1979	0.74	111	0.69	173	0.65	163	0.57	200	647
1980	0.74	111	0.74	185	0.69	173	0.63	221	690
1981	0.74	111	0.74	185	0.74	185	0.69	242	723
1982	0.74	111	0.74	185	0.74	185	0.74	259	740
1983	0.74	111	0.74	185	0.74	185	0.74	259	740
1984	0.74	111	0.74	185	0.74	185	0.74	259	740
1985	0.74	111	0.74	185	0.74	185	0.74	259	740
1986	0.74	111	0.74	185	0.74	185	0.74	259	740
1987	0.74	111	0.74	185	0.74	185	0.74	259	740
1988	0.72	108	0.74	185	0.74	185	0.74	259	737
1989	0.72	108	0.72	180	0.74	185	0.74	259	732
1990	0.72	108	0.72	180	0.72	180	0.74	259	727
1991	0.71	107	0.72	180	0.72	180	0.72	252	719
1992	0.71	107	0.71	178	0.72	180	0.72	252	717
1993	0.67	101	0.71	178	0.71	178	0.72	252	709
1994	0.67	101	0.67	168	0.71	178	0.71	249	696
1995	0.67	101	0.67	168	0.67	168	0.71	249	686
Total									14,504

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a. Annual per-hectare yield at maturity: 17.5 tons of bunches with 20 percent oil extraction, or 3.5 tons of oil, and 0.74 tons of kernels.

Source: Stanford Research Institute.

Table 17

PALM OIL PRODUCTION ON A 1,500-HECTARE OIL PALM PLANTATION UNDER JOLO CONDITIONS WITH AN 80-INCH ANNUAL RAINFALL[a]

1971-1995

(Tons)

	Bunches									Palm Oil				
Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output	1967	1968	1969	1970	Total Output
1971	150 x 4 =	600	250 x 0 =	0	500 x 0 =	0	600 x 0 =	0	600	60	0	0	0	60
1972	8	1,200	4	1,000	0	0	0	0	2,200	150	100	0	0	250
1973	11	1,650	8	2,000	4	2,000	0	0	5,650	225	250	200	0	675
1974	13	1,950	11	2,750	8	4,000	4	2,400	11,100	330	375	500	240	1,445
1975	15	2,250	13	3,250	11	5,500	8	4,800	15,800	420	550	750	600	2,320
1976	17	2,550	15	3,750	13	6,500	11	6,600	19,400	495	700	1,100	900	3,195
1977	19	2,850	17	4,250	15	7,500	13	7,800	22,400	570	825	1,400	1,320	4,115
1978	21	3,150	19	4,750	17	8,500	15	9,000	25,400	645	950	1,650	1,680	4,925
1979	21	3,150	21	5,250	19	9,500	17	10,200	28,100	675	1,075	1,900	1,980	5,630
1980	21	3,150	21	5,250	21	10,500	19	11,400	30,300	675	1,125	2,150	2,280	6,230
1981	21	3,150	21	5,250	21	10,500	21	12,600	31,500	675	1,125	2,250	2,580	6,630
1982	21	3,150	21	5,250	21	10,500	21	12,600	31,500	675	1,125	2,250	2,700	6,750
1983	21	3,150	21	5,250	21	10,500	21	12,600	31,500	675	1,125	2,250	2,700	6,750
1984	21	3,150	21	5,250	21	10,500	21	12,600	31,500	675	1,125	2,250	2,700	6,750
1985	21	3,150	21	5,250	21	10,500	21	12,600	31,500	675	1,125	2,250	2,700	6,750
1986	21	3,150	21	5,250	21	10,500	21	12,600	31,500	675	1,125	2,250	2,700	6,750
1987	21	3,150	21	5,250	21	10,500	21	12,600	31,500	675	1,125	2,250	2,700	6,750
1988	20	3,000	21	5,250	21	10,500	21	12,600	31,350	630	1,125	2,250	2,700	6,705
1989	20	3,000	20	5,000	21	10,500	21	12,600	31,100	630	1,050	2,250	2,700	6,630
1990	20	3,000	20	5,000	20	10,000	21	12,600	30,600	630	1,050	2,100	2,700	6,480
1991	19	2,850	20	5,000	20	10,000	20	12,000	29,850	570	1,050	2,100	2,520	6,240
1992	19	2,850	19	4,750	20	10,000	20	12,000	29,600	570	950	2,100	2,520	6,140
1993	19	2,850	19	4,750	19	9,500	20	12,000	29,100	570	950	1,900	2,520	5,940
1994	18	2,700	19	4,750	19	9,500	19	11,400	28,350	540	950	1,900	2,280	5,670
1995	18	2,700	18	4,500	19	9,500	19	11,400	28,100	540	900	1,900	2,280	5,620
Total														125,400

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a. Annual per-hectare yield at maturity: 21 tons of bunches at 21.5 percent oil extraction, or 4.5 tons of oil, and 0.88 tons of kernels.

Source: Stanford Research Institute.

Table 18

PALM KERNEL PRODUCTION ON A 1,500-HECTARE PALM OIL PLANTATION UNDER JOLO CONDITIONS WITH AN 80-INCH ANNUAL RAINFALL
1971-1995
(Tons)

Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output
1971	150 x 0.17 =	26	250 x 0 =	0	500 x 0 =	0	600 x 0 =	0	26
1972	0.34	51	0.17	43	0	0	0	0	94
1973	0.46	69	0.34	85	0.17	85	0	0	239
1974	0.55	83	0.46	115	0.34	170	0.17	102	470
1975	0.63	95	0.55	138	0.46	230	0.34	204	667
1976	0.71	107	0.63	158	0.55	275	0.46	276	816
1977	0.80	120	0.71	178	0.63	315	0.55	330	943
1978	0.88	132	0.80	200	0.71	355	0.63	378	1,065
1979	0.88	132	0.88	220	0.80	400	0.71	426	1,178
1980	0.88	132	0.88	220	0.88	440	0.80	480	1,272
1981	0.88	132	0.88	220	0.88	440	0.88	528	1,320
1982	0.88	132	0.88	220	0.88	440	0.88	528	1,320
1983	0.88	132	0.88	220	0.88	440	0.88	528	1,320
1984	0.88	132	0.88	220	0.88	440	0.88	528	1,320
1985	0.88	132	0.88	220	0.88	440	0.88	528	1,320
1986	0.88	132	0.88	220	0.88	440	0.88	528	1,320
1987	0.88	132	0.88	220	0.88	440	0.88	528	1,320
1988	0.84	126	0.88	220	0.88	440	0.88	528	1,314
1989	0.84	126	0.84	210	0.88	440	0.88	528	1,304
1990	0.84	126	0.84	210	0.84	420	0.88	528	1,284
1991	0.80	120	0.84	210	0.84	420	0.84	504	1,254
1992	0.80	120	0.80	200	0.84	420	0.84	504	1,244
1993	0.80	120	0.80	200	0.80	400	0.84	504	1,224
1994	0.76	114	0.80	200	0.80	400	0.80	480	1,194
1995	0.76	114	0.76	190	0.80	400	0.80	480	1,184
Total									26,012

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a. Annual per-hectare yield at maturity: 21 tons of bunches with 21.5 percent oil extraction, or 4.5 tons of oil, and 0.88 tons of kernels.

Source: Stanford Research Institute.

Table 19

PALM OIL PRODUCTION ON A 1,000-HECTARE OIL PALM PLANTATION UNDER JOLO CONDITIONS WITH AN 80-INCH ANNUAL RAINFALL[a]

1971-1995

(Tons)

	Bunches									Palm Oil				
Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output	1967	1968	1969	1970	Total Output
1971	150 x 4 =	600	250 x 0 =	0	250 x 0 =	0	350 x 0 =	0	600	60	0	0	0	60
1972	8	1,200	4	1,000	0	0	0	0	2,200	150	100	0	0	250
1973	11	1,650	8	2,000	4	1,000	0	0	4,650	225	250	100	0	575
1974	13	1,950	11	2,750	8	2,000	4	1,400	8,100	330	375	250	140	1,095
1975	15	2,250	13	3,250	11	2,750	8	2,800	11,050	420	550	375	350	1,695
1976	17	2,550	15	3,750	13	3,250	11	3,850	13,400	495	700	550	525	2,270
1977	19	2,850	17	4,250	15	3,750	13	4,550	15,400	570	825	700	770	2,865
1978	21	3,150	19	4,750	17	4,250	15	5,250	17,400	645	950	825	980	3,400
1979	21	3,150	21	5,250	19	4,750	17	5,950	19,100	675	1,075	950	1,155	3,855
1980	21	3,150	21	5,250	21	5,250	19	6,650	20,300	675	1,125	1,075	1,330	4,205
1981	21	3,150	21	5,250	21	5,250	21	7,350	21,000	675	1,125	1,125	1,505	4,430
1982	21	3,150	21	5,250	21	5,250	21	7,350	21,000	675	1,125	1,125	1,575	4,500
1983	21	3,150	21	5,250	21	5,250	21	7,350	21,000	675	1,125	1,125	1,575	4,500
1984	21	3,150	21	5,250	21	5,250	21	7,350	21,000	675	1,125	1,125	1,575	4,500
1985	21	3,150	21	5,250	21	5,250	21	7,350	21,000	675	1,125	1,125	1,575	4,500
1986	21	3,150	21	5,250	21	5,250	21	7,350	21,000	675	1,125	1,125	1,575	4,500
1987	21	3,150	21	5,250	21	5,250	21	7,350	21,000	675	1,125	1,125	1,575	4,500
1988	20	3,000	21	5,250	21	5,250	21	7,350	20,850	630	1,125	1,125	1,575	4,455
1989	20	3,000	20	5,000	21	5,250	21	7,350	20,600	630	1,050	1,125	1,575	4,380
1990	20	3,000	20	5,000	20	5,000	21	7,350	20,300	630	1,050	1,050	1,575	4,305
1991	19	2,850	20	5,000	20	5,000	20	7,000	19,850	570	1,050	1,050	1,470	4,140
1992	19	2,850	19	4,750	20	5,000	20	7,000	19,600	570	950	1,050	1,470	4,040
1993	19	2,850	19	4,750	19	4,750	20	7,000	19,350	570	950	950	1,470	3,940
1994	18	2,700	19	4,750	19	4,750	19	6,650	18,850	540	950	950	1,330	3,770
1995	18	2,700	18	4,500	19	4,750	19	6,650	18,600	540	900	950	1,330	3,720
Total														84,450

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a. Annual per-hectare yield at maturity: 21 tons of bunches with 21.5 percent oil extraction, or 4.5 tons of oil, and 0.88 tons of kernels.

Source: Stanford Research Institute.

Table 20

PALM KERNEL PRODUCTION ON A 1,000-HECTARE OIL PALM PLANTATION UNDER JOLO CONDITIONS WITH AN 80-INCH ANNUAL RAINFALL[a]

1971-1995

(Tons)

Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output
1971	150 x 0.17 =	26	250 x 0 =	0	250 x 0 =	0	350 x 0 =	0	26
1972	0.34	51	0.17	43	0	0	0	0	94
1973	0.46	69	0.34	85	0.17	43	0	0	197
1974	0.55	83	0.46	115	0.34	85	0.17	60	343
1975	0.63	95	0.55	138	0.46	115	0.34	119	467
1976	0.71	107	0.63	158	0.55	138	0.46	161	564
1977	0.80	120	0.71	178	0.63	158	0.55	193	649
1978	0.88	132	0.80	200	0.71	178	0.63	221	731
1979	0.88	132	0.88	220	0.80	200	0.71	249	801
1980	0.88	132	0.88	220	0.88	220	0.80	280	852
1981	0.88	132	0.88	220	0.88	220	0.88	308	880
1982	0.88	132	0.88	220	0.88	220	0.88	308	880
1983	0.88	132	0.88	220	0.88	220	0.88	308	880
1984	0.88	132	0.88	220	0.88	220	0.88	308	880
1985	0.88	132	0.88	220	0.88	220	0.88	308	880
1986	0.88	132	0.88	220	0.88	220	0.88	308	880
1987	0.88	132	0.88	220	0.88	220	0.88	308	880
1988	0.84	126	0.88	220	0.88	220	0.88	308	874
1989	0.84	126	0.84	210	0.88	220	0.88	308	864
1990	0.84	126	0.84	210	0.84	210	0.88	308	854
1991	0.80	120	0.84	210	0.84	210	0.84	294	834
1992	0.80	120	0.80	200	0.84	210	0.84	294	824
1993	0.80	120	0.80	200	0.80	200	0.84	294	814
1994	0.76	114	0.80	200	0.80	200	0.80	280	794
1995	0.76	114	0.76	190	0.80	200	0.80	280	784
Total									17,526

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a. Annual per-hectare yield at maturity: 21 tons of bunches with 21.5 percent oil extraction, or 4.5 tons of oil, and 0.88 tons of kernels.

Source: Stanford Research Institute.

V. Optimal conditions of environment and planting material (Tables 21 and 22). A plantation of 1,000 hectares yielding at full maturity 24 tons of bunches at 21.5 percent oil extraction will yield 5.2 tons of palm oil per hectare per year plus 0.96 tons of kernels per hectare per year (4 percent).

VI. Optimal conditions of environment and planting material (Table 23). A plantation of 2,000 hectares yielding at full maturity 24 tons of bunches at 21.5 percent oil extraction will yield 5.2 tons of palm oil per hectare per year plus 0.96 tons of kernels per hectare per year (4 percent).

In giving the production data in Tables 13 through 22 for the above plantations of different sizes, with varying growing conditions and planting schedules, an estimated life span of 25 years for the plantation is assumed, with full maturity of the crop, in terms of yield of bunches and kernels and of oil-extraction ratio, being reached from 8 to 11 years after planting, depending on the planting schedule. These production figures are summarized below:

Size of Plantation (Hectares)	Rainfall (Yearly mean, inches)	Total Yield over 25 years		Table Nos.
		Oil (tons)	Kernels (tons)	
1,500	70	97,855	21,516	13-14
1,000	70	65,965	14,504	15-16
1,500	80	125,400	26,012	17-18
1,000	80	84,450	17,526	19-20
1,000*	80	100,360	19,646	21-22

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* Based on optimal conditions of climate and soil not considered attainable in the Tiptipon area.

Table 21

PALM OIL PRODUCTION ON A 1,000-HECTARE OIL PALM PLANTATION UNDER OPTIMAL CONDITIONS[a]

1971-1995

(Tons)

	Bunches									Palm Oil				
Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output	1967	1968	1969	1970	Total Output
1971	150 x 5	= 750	250 x 0	= 0	250 x 0	= 0	350 x 0	= 0	750	75	0	0	0	75
1972	10	1,500	5	1,250	0	0	0	0	2,750	180	125	0	0	305
1973	15	2,250	10	2,500	5	1,250	0	0	6,000	315	300	125	0	740
1974	18	2,700	15	3,750	10	2,500	5	1,750	10,700	465	525	300	175	1,465
1975	21	3,150	18	4,500	15	3,750	10	3,500	14,900	570	775	525	420	2,290
1976	22.5	3,375	21	5,250	18	4,500	15	5,250	18,375	660	950	775	735	3,120
1977	24	3,600	22.5	5,625	21	5,250	18	6,300	20,775	735	1,100	950	1,085	3,870
1978	24	3,600	24	6,000	22.5	5,625	21	7,350	22,575	780	1,225	1,100	1,330	4,435
1979	24	3,600	24	6,000	24	6,000	22.5	7,875	23,475	780	1,300	1,225	1,540	4,845
1980	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,715	5,095
1981	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,820	5,200
1982	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,820	5,200
1983	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,820	5,200
1984	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,820	5,200
1985	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,820	5,200
1986	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,820	5,200
1987	24	3,600	24	6,000	24	6,000	24	8,400	24,000	780	1,300	1,300	1,820	5,200
1988	23	3,450	24	6,000	24	6,000	24	8,400	23,850	720	1,300	1,300	1,820	5,140
1989	23	3,450	23	5,750	24	6,000	24	8,400	23,600	720	1,200	1,300	1,820	5,040
1990	22	3,300	23	5,750	23	5,750	24	8,400	23,200	690	1,200	1,200	1,820	4,910
1991	22	3,300	22	5,500	23	5,750	23	8,050	22,600	690	1.150	1,200	1,680	4,720
1992	21	3,150	22	5,500	22	5,500	23	8,050	22,200	660	1,150	1,150	1,680	4,640
1993	21	3,150	21	5,250	22	5,500	22	7,700	21,600	660	1,100	1,150	1,610	4,520
1994	20	3,000	21	5,250	21	5,250	22	7,700	21,200	600	1,100	1,100	1,610	4,410
1995	20	3,000	20	5,000	21	5,250	21	7,350	20,600	600	1,100	1,100	1,540	4,340
Total														100,360

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a. Annual per-hectare yield at maturity: 24 tons of bunches with 21.5 percent oil extraction, or 5.2 tons of oil, and 0.96 tons of kernels.

Source: Stanford Research Institute.

Table 22

PALM KERNEL PRODUCTION ON A 1,000-HECTARE OIL PALM PLANTATION UNDER OPTIMAL CONDITIONS[a]
1971-1995
(Tons)

Year	1967 Planting		1968 Planting		1969 Planting		1970 Planting		Total Output
1971	150 x 0.20 =	30	250 x 0 =	0	250 x 0 =	0	350 x 0 =	0	30
1972	0.40	60	0.20	50	0	0	0	0	110
1973	0.60	90	0.40	100	0.20	50	0	0	240
1974	0.72	108	0.60	150	0.40	100	0.20	70	428
1975	0.84	126	0.72	180	0.60	150	0.40	140	596
1976	0.90	135	0.84	210	0.72	180	0.60	210	735
1977	0.96	144	0.90	225	0.84	210	0.72	252	831
1978	0.96	144	0.96	240	0.90	225	0.84	294	903
1979	0.96	144	0.96	240	0.96	240	0.90	315	939
1980	0.96	144	0.96	240	0.96	240	0.96	336	960
1981	0.96	144	0.96	240	0.96	240	0.96	336	960
1982	0.96	144	0.96	240	0.96	240	0.96	336	960
1983	0.96	144	0.96	240	0.96	240	0.96	336	960
1984	0.96	144	0.96	240	0.96	240	0.96	336	960
1985	0.96	144	0.96	240	0.96	240	0.96	336	960
1986	0.96	144	0.96	240	0.96	240	0.96	336	960
1987	0.96	144	0.96	240	0.96	240	0.96	336	960
1988	0.92	138	0.96	240	0.96	240	0.96	336	954
1989	0.92	138	0.92	230	0.96	240	0.96	336	944
1990	0.88	132	0.92	230	0.92	230	0.96	336	928
1991	0.88	132	0.88	220	0.92	230	0.92	322	904
1992	0.84	126	0.88	220	0.88	220	0.92	322	888
1993	0.84	126	0.84	210	0.88	220	0.88	308	864
1994	0.80	120	0.84	210	0.84	210	0.88	308	848
1995	0.80	120	0.80	200	0.84	210	0.84	294	824
Total									19,646

[a] Annual per-hectare yield at maturity: 24 tons of bunches with 21.5 percent oil extraction, or 5.2 tons of oil, and 0.96 tons of kernels.

Source: Stanford Research Institute.

Table 23

FACTORY CAPACITY REQUIRED AT 400 HOURS/MONTH WITH A PEAK MONTH OF 12.5 PERCENT OF ANNUAL TOTAL

1971-1982

(Tons per Hour)

Harvest Year	Case I[a]	Case II[b]	Case III[c]	Case IV[d]	Case V[e]	Case VI[f]
1971	0.09	0.09	0.19	0.19	0.23	0.39
1972	0.39	0.39	0.69	0.69	0.86	1.56
1973	1.08	0.92	1.76	1.45	1.87	3.51
1974	2.25	1.70	3.47	2.53	3.34	6.48
1975	3.53	2.52	4.94	3.45	4.66	9.14
1976	4.63	3.23	6.06	4.19	5.74	11.36
1977	5.53	3.81	7.00	4.81	6.49	12.89
1978	6.34	4.35	7.94	5.44	7.05	14.06
1979	7.67	4.79	8.78	5.97	7.34	14.65
1980	7.75	5.08	9.47	6.34	7.50	15.00
1981	8.02	5.36	9.84	6.56	7.50	15.00
1982	8.20	5.47	9.84	6.56	7.50	15.00

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a. 1,500 hectares @ 17.5 tons of bunches.
b. 1,000 hectares @ 17.5 tons of bunches.
c. 1,500 hectares @ 21 tons of bunches.
d. 1,000 hectares @ 21 tons of bunches.
e. 1,000 hectares @ 24 tons of bunches.
f. 2,000 hectares @ 24 tons of bunches.

Source: Stanford Research Institute.

Factory Capacity

The capacity of the palm oil factory is normally calculated on the basis of the amount of fresh fruit bunches to be treated per hour. In this study the following is assumed:

a. A two-shift labor force in the Jolo factory, or twenty-five 16-hour days, or 400 working hours a month

b. A peak-month yield of 12.5 percent of the yearly total of bunches

c. Staggered planting programs as discussed earlier

It should be noted that the yield is never evenly distributed throughout the year. In general the longer and the more pronounced the dry season the greater the variations in monthly yields and the higher the peak.

In older plantations the monthly variations are less pronounced than in the younger ones.

In Table 23 the factory capacity per hour is given for each of the five cases described above; the table also includes Case VI, i.e., a 2,000-hectare plantation with a bunch production of 24 tons per hectare per year, which is not considered to be attainable in the Tiptipon area.

From Table 23 it can be concluded that the Jolo case (I) under study, i.e., 1,500 hectares yielding 17.5 tons of bunches per hectare at full maturity, would require a factory capacity of nearly 9 tons of bunches hourly. The larger production of Case III, i.e., 1,500 hectares yielding 21 tons of bunches per hectare at full maturity, would require a milling capacity of 9.84 tons per hour. Considering that yields in Case I may exceed expectations and that monthly peaks in older plantings decrease, it is reasonable to take for both Case I and Case III a factory with an hourly milling capacity of 9 tons of bunches. Similarly, for Cases II and IV an hourly milling capacity of 6 tons of bunches would be acceptable.

Factory Costs

According to the manufacturers* of nearly all palm oil factories in the world, factory prices are as follows:

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* Gebr. Stork & Co's, Apparatenfabriek N.V., Amsterdam.

1. A complete beltdriven mill including buildings, power plant, oil storage, and water supply for a capacity of 6 tons per hour:

   US$414,000 (₱1,656,000) f.o.b. Amsterdam

2. The same for a capacity of 9 tons per hour:

   US$603,000 (₱2,412,000) f.o.b. Amsterdam

These costs are increased by 10 percent to obtain the c.i.f. values comprising freight and insurance, and the landing cost, erection cost, and local transport. In this study an exemption from import duties and local taxes in the Philippines is assumed.

A palm oil factory can be built in stages to cope with the normally increasing production of an immature plantation. In this calculation it is assumed that the factory would be built in stages. In the 12th year (in our schedule, 1978) a factory at a full hourly capacity of 9 tons of bunches is required.

The first stage of the factory with a capacity of 3 tons would have to be ordered in 1972 (50 percent of which must be paid in 1972 and 50 percent in 1973), be erected in 1974, and go in operation in 1975. The second stage (up to 5 tons) must be ready in 1976. The final stage (up to 9 tons) must be ready in 1978 in order to process the full crop from 1978 on, when the plantation would be in full bearing, with an annual average yield of 5,000 tons of oil during a period of 18 years (1978-95). (See production figures, Table 13.)

The first harvests would be small, viz., 300, 1,250, 3,450, and 7,200 tons of bunches producing 25, 125, 370, and 850 tons of oil, respectively, during the first four ears (1971-74). During these earlier years the harvests can best be handled by Stork hydraulic handpresses (each installation costing ₱8,000) required as follows: one in 1970, two in 1972, and an additional two in 1973.

Appendix II may serve as a general schedule for ordering, shipping, and erecting a factory. A schedule for planting (hectares) in accordance with each of the six cases mentioned earlier is given below.

Case	First Year	Second Year	Third Year	Fourth Year	Total Hectares
II, IV, V	150	250	250	350	1,000
I, III	150	250	500	600	1,500
VI	250	500	500	750	2,000

Capital Investments

Table 24 gives the investment cost from establishment to maturity of the 1,500-hectare plantation described earlier as Case I. The detailed figures for each of the first five capital-investment items in the table are shown in Tables 25 through 29. The total overall capital investment up to maturity amounts to about ₱6,606 per hectare. This is a more or less normal figure by international standards. It should be noted, however, that while the factory to be imported is free from duties and taxes, the land price and building cost are high.

Factory

The financial requirements for a 9-ton factory ready for service in the project under study are given in Table 24. Note (1) the cost of such a factory,* ₱2,412,000, or ₱2,653,200 including the 10 percent charges described under factory costs; (2) payments of 50 percent on order and 50 percent on shipment; and (3) erection in stages as described above. Table 24 also shows the other capital items involved from the establishment of a 1,500-hectare plantation to maturity of the crop, and it includes a wharf and complete pumphouse estimated at ₱150,000 and ₱100,000, respectively.

Land Prices

The following quotations (per hectare) reflect recent land values:

Basilan Island: land acquired through the Bureau of Forestry, ₱35-₱50
Sulu: forested land, ₱150; coconut land, ₱1,000-₱1,500
Tawitawi: cogon land, ₱200; public land, ₱100

According to the Project Study Report for the Kiram Abaca Development Project, 1965, the price of the land of the Kiram property is valued at ₱1,000 per hectare. As had been pointed out, most of the property is heavily infested with cogon.

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* These figures do not include the five Stork hydraulic handpress installations at ₱8,000 each.

Table 24

INVESTMENT COST FROM ESTABLISHMENT TO MATURITY FOR A 1,500-HECTARE OIL PALM PLANTATION, JOLO[a]

1967-1977

(Pesos)

Item	First Year, 1967	Second Year, 1968	Third Year, 1969	Fourth Year, 1970	Fifth Year, 1971	Sixth Year, 1972	Seventh Year, 1973	Eighth Year, 1974	Ninth Year, 1975	Tenth Year, 1976	Eleventh Year, 1977	Subtotals	Total
1. Field costs (land development)	₱ 180,750	₱350,750	₱ 726,250	₱ 997,250	₱403,000	₱ 300,000	₱ 162,000	₱	₱	₱	₱	₱	₱3,120,000
2. Buildings	297,000	100,000	194,000	203,000	130,000								924,000
3. Vehicular equipment	222,000	12,500	64,500	43,000									342,000
4. Machinery, equipment, tools	49,500	58,500	38,500	45,000	23,000	21,000							235,500
5. Personnel	157,100	187,800	223,900	275,700									844,500
6. Factory				8,000		16,000	16,000					(40,000)[h]	
						1,016,400	1,016,400					(2,032,800)[c]	2,693,200
							123,200	123,200		187,000	187,000	(620,400)[d]	
7. Land	1,500,000												1,500,000
8. Wharf and pumphouse									50,000	100,000	100,000		250,000
Total	₱2,406,350	₱709,550	₱1,247,150	₱1,571,950	₱556,000	₱1,353,400	₱1,317,600	₱123,200	₱50,000	₱287,000	₱287,000		₱9,909,200[e]

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a. At maturity, producing 17.5 tons per hectare at 20 percent oil recovery.
b. Five hand presses.
c. First stage, up to 3-ton capacity.
d. Second stage, up to 5 tons, and third stage, up to 9 tons.
e. Cost per hectare is ₱6,606.

Source: Stanford Research Institute.

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Table 25

ESTIMATED FIELD COSTS[a] FOR A 1,500-HECTARE OIL PALM PLANTATION, JOLO 1967-1970 (Pesos)

Year	1967 Planting	1968 Planting	1969 Planting	1970 Planting	Total (1,500 ha)
1967	₱180,750	₱	₱	₱	₱ 180,750
1968	49,500	301,250			350,750
1969	41,250	82,500	602,500		726,250
1970	40,500	68,750	165,000	723,000	997,250
1971		67,500	137,500	198,000	403,000
1972			135,000	165,000	300,000
1973				162,000	162,000
Total	₱312,000	₱520,000	₱1,040,000	₱1,248,000	₱3,120,000[b]

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a. Based on cost data in Table 11.
b. The cost per hectare is ₱2,080.

Source: Stanford Research Institute.

Table 26

BUILDING COSTS FOR A 1,500-HECTARE OIL PALM PLANTATION, JOLO
1967-1971
(Pesos)

Buildings	1967 No.	1967 Cost	1968 No.	1968 Cost	1969 No.	1969 Cost	1970 No.	1970 Cost	1971 No.	1971 Cost	Total Cost
Administrative office	1	₱ 22,000		₱		₱		₱		₱	₱ 22,000
Manager's residence	1	18,000									18,000
Department head's residence	3	42,000	1	14,000							56,000
Employee cottage	8	64,000	2	16,000	5	40,000	7	56,000			176,000
Laborer's housing											
20-bachelor unit	1	10,000	1	10,000	1	10,000	1	10,000	1	10,000	50,000
6-family unit	5	60,000	5	60,000	10	120,000	10	120,000	10	120,000	480,000
Infirmary	1	21,000									21,000
Guardhouse machine parking	1	6,000									6,000
Repair bays and spare parts and implement shed	1	54,000									54,000
Warehouse					1	24,000					24,000
Guesthouse							1	17,000			17,000
Total		₱297,000		₱100,000		₱194,000		₱203,000		₱130,000	₱924,000[a]

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a. The cost per hectare is ₱616.

Source: Stanford Research Institute.

Table 27

VEHICULAR EQUIPMENT COSTS FOR A 1,500-HECTARE OIL PALM PLANTATION, JOLO

1967-1970

(Pesos)

Item	1967		1968		1969		1970		Total	
	No.	Cost	No.	Cost	No.	Cost	No.	Cost	No.	Cost
Wheeltractor and plow[a]	3	₱ 64,500	--	₱ --	2	₱43,000	1	₱21,500	6	₱129,000
Wheeltractor and harrow	1.5	32,250	--	--	0.5	10,750	0.5	10,750	2.5	53,750
Wheeltractor and dozer	1.5	32,250	--	--	0.5	10,750	0.5	10,750	2.5	53,750
Five-ton trucks @ ₱28,000	2	56,000	--	--	--	--	--	--	2	56,000
Jeeps @ ₱12,500	2	25,000	1	12,500	--	--	--	--	3	37,500
Tractor trailers @ ₱3,000	4	12,000	--	--	--	--	--	--	4	12,000
Total	14	₱222,000	1	₱12,500	3	₱64,500	2	₱43,000	20	₱342,000[b]

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a. The cost of one wheeltractor plus equipment is ₱21,500.
b. The cost per hectare is ₱228.

Source: Stanford Research Institute.

Table 28

COST OF MACHINERY, EQUIPMENT, AND TOOLS[a] FOR A 1,500-HECTARE PLANTATION, JOLO
1967-1972
(Pesos)

Item	1967	1968	1969	1970	1971	1972	Total
Office furniture and equipment	₱ 3,000	₱ 3,000	₱ 3,000	₱ 3,000	₱ --	₱ --	₱ 12,000
Equipment for medical and dental clinic	6,000	6,000	6,000	6,000	--	--	24,000
Plantation tools	5,000	5,000	5,000	3,000	2,000	--	20,000
Power tiller and mower	--	--	--	6,000	--	--	6,000
Repair shop tools and equipment	10,000	20,000	10,000	10,000	10,000	10,000	70,000
Water supply, weigh-bridge loading platforms	25,000	24,500	14,500	16,000	10,000	10,000	100,000
Miscellaneous	500	--	--	1,000	1,000	1,000	3,500
Total	₱49,500	₱58,500	₱38,500	₱45,000	₱23,000	₱21,000	₱235,500[b]

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a. Exclusive of factory equipment.
b. The cost per hectare is ₱157.

Source: Stanford Research Institute.

Table 29

REGULAR PERSONNEL[a] FOR A 1,500-HECTARE OIL PALM PLANTATION, JOLO
1967-1970
(Pesos)

Personnel	1967		1968		1969		1970		Total
	No.	Salary	No.	Salary	No.	Salary	No.	Salary	
Manager's Office									
General Manager	1	₱ 38,400	1	₱ 38,400	1	₱ 38,400	1	₱ 38,400	₱153,600
Secretary	1	4,800	1	4,800	1	5,400	1	5,400	20,400
Administrative Department									
Department head/ bookkeeper	1	12,000	1	12,000	1	14,000	1	14,000	52,000
Part-time doctor		--		--		--		--	--
Nurses	1	3,600	1	3,600	2	7,200	2	7,200	21,600
Clerks	1	3,000	2	6,000	4	12,000	6	18,000	39,000
Warehouseman	--	--	--	--	--	--	1	3,000	3,000
Chief guard	1	3,000	1	3,000	1	3,000	1	3,000	12,000
Security guards	10	18,000	10	18,000	10	18,000	10	18,000	72,000
Office helpers	1	1,500	2	3,000	3	4,500	5	7,500	16,500
Agricultural Department									
Agronomist	1	12,000	2	24,000	2	28,000	2	28,000	92,000
Clerks	1	3,000	2	6,000	2	6,000	2	6,000	21,000
Foreman	2	9,600	3	14,400	4	19,200	5	24,000	67,200
Engineering Department									
Chief Engineer	1	12,000	1	12,000	1	14,000	1	14,000	52,000
Assistant Engineer	1	9,600	1	9,600	1	10,600	1	10,600	40,400
Foreman	1	5,000	1	5,000	2	10,000	4	20,000	40,000
Electrician	1	4,000	1	4,000	1	4,000	2	8,000	20,000
Mechanic	2	8,000	3	12,000	5	20,000	8	32,000	72,000
Laboratory man	--	--	--	--	--	--	1	4,200	4,200
Jeep driver	2	4,800	3	7,200	3	7,200	3	7,200	26,400
Truck driver	2	4,800	2	4,800	2	4,800	2	4,800	19,200
Total		₱157,100		₱187,800		₱226,300		₱273,300	₱844,500[b]

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a. Exclusive of unskilled factory and field labor.
b. The cost per hectare is ₱563.

Estimated Annual Operating Costs for a 1500-hectare Plantation in Full Bearing at Jolo

In the cost price calculations that follow, the plantation is assumed to be in full bearing, which starts (see Tables 13 and 14) in the eighth year of harvesting (1978) and carries on up to the last year (1995), i.e., a period of 18 years with an average annual production of 5,000 tons of oil and 1,065 tons of kernels. In this connection, normally the first harvest is 3.5 years after field planting, but with the normal application of a staggered planting program the whole plantation comes into harvest 6.5 years after the first field planting.

Table 30 summarizes these operating costs; bracketed numbers throughout the discussion refer to numbered items in the table.

Direct Costs

Field Costs [Table 30, No. 1]

The estimated annual field costs to operate a 1500-hectare plantation at Jolo in full bearing are given below.[*]

Item	Per Hectare	Per Ton of Bunches	Per Ton of Oil
Upkeep, 24 man-days a year	₱ 96.00	₱ 5.71	₱ 28.80
Pruning, 4 man-days a year	16.00	.95	4.80
Harvesting, 2.25 man-days per ton [1b]	151.23	9.00	45.37
Transport, ₱0.05 per ton km [1c]	25.20	1.50	7.56
Fertilizing 6 man-days	24.00	1.43	7.20
Materials[**]	160.00	9.52	48.00
Paths, anti-erosion measures, and drainage, 12 man-days	48.00	2.86	14.40
Control of pests and diseases, 4 man-days	16.00	.95	4.80
Materials	16.00	.95	4.80
Total estimated operating cost	₱552.43	₱32.87	₱165.73

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[*] Figures used are based on the following calculations:
3.333 tons of oil per hectare (average annual yield for 1978-1995 divided by number of hectares: 5,000/1,500 = 3.333).

16.803 tons of bunches per hectare (average annual yield for 1978-1995 divided by number of hectares: 25,204/1,500 = 16.803).

[**] Two hundred kg of rock phosphate broadcast; circle application of 150 kg of ammonium sulphate, 200 kg of potassium chloride, and 100 kg of magnesium sulphate.

Table 30

ESTIMATED PRODUCTION FIGURES AND OPERATING COSTS FOR THE PROPOSED 1,500-HECTARE OIL PALM PLANTATION, JOLO 1971-1995

	1971	1972	1973	1974	1975[a]	1976	1977	1978	1979	1980[b]	1981	1982	1983	1984-87[c]	1988-95[c]
Production (tons)[d]															
Bunches	300	1,250	3,450	7,200	11,300	14,825	17,700	25,204	25,204	25,204	25,204	25,204	25,204	25,204	25,204
Oil	25	125	370	850	1,490	2,185	2,900	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Kernels	12	52	143	299	471	619	713	1,065	1,065	1,065	1,065	1,065	1,065	1,065	1,065
Estimated Operating Costs (pesos)															
1. Field costs															
a. Upkeep, etc.	₱564,000	₱564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000	₱ 564,000
b. Harvesting	2,700	11,250	31,050	64,800	101,700	133,125	159,300	226,838	226,838	226,838	226,838	226,838	226,838	226,838	226,838
c. Transport	450	1,875	5,175	10,800	16,950	22,238	26,550	37,806	37,806	37,806	37,806	37,806	37,806	37,806	37,806
2. Manufacturing oil	2,700	11,250	31,050	64,800	64,085	85,827	98,223	154,600	154,600	154,600	154,600	154,600	154,600	154,600	154,600
3. Manufacturing kernels	--	--	--	--	11,747	14,002	14,206	20,278	20,278	20,278	20,278	20,278	20,278	20,278	20,278
4. Transport oil to Manila	1,978	9,888	29,267	67,235	52,150	76,475	101,500	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
5. Transport kernels to Manila	--	--	--	--	30,380	39,926	47,924	68,693	68,693	68,693	68,693	68,693	68,693	68,693	68,693
6. Upkeep building	--	--	--	5,000	7,500	10,000	20,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
7. Repair and maintenance (3% value of vehicular equipment, machinery, etc.)	2,000	2,000	3,000	4,000	6,000	9,000	10,000	17,325	17,325	17,325	17,325	17,325	17,325	17,325	17,325
8. Materials (fuel, etc.)	1,000	1,000	2,000	2,000	2,000	4,000	6,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000
9. Supervision, administration, and hospital expenses	337,055	337,055	337,055	337,055	337,055	337,055	337,055	342,055	342,055	342,055	342,055	342,055	342,055	342,055	342,055
10. One percent taxes on fixed capital investment	--	--	--	--	--	--	--	--	--	11,327	22,651	33,981	45,308	56,635	56,635
11. Insurance	21,725	21,935	22,090	31,490	41,450	12,570	45,975	21,855	21,855	21,855	21,855	21,855	21,855	21,855	21,855
12. Depreciation[e]															
a. Handpresses	730	3,650	10,800	24,820	--	--	--	--	--	--	--	--	--	--	--
b. Land development (18 years)	--	--	--	--	--	--	--	173,333	173,333	173,333	173,333	173,333	173,333	173,333	173,333
c. Buildings (10 years)	--	--	--	--	--	--	--	123,600	123,600	123,600	123,600	123,600	123,600	123,600	--
d. Machinery, vehicular equipment, etc. (10 years)	--	--	--	--	--	--	--	267,750	267,750	267,750	267,750	267,750	267,750	267,750	--
e. Wharf and pumphouse (10 years)	--	--	--	--	--	--	--	25,000	25,000	25,000	25,000	25,000	25,000	25,000	--
Total annual operating cost before taxes and interest	₱934,338	₱963,903	₱1,035,487	₱1,176,000	₱1,235,017	₱1,334,518	₱1,430,733	₱2,260,133	₱2,260,133	₱2,271,160	₱2,282,787	₱2,291,114	₱2,305,441	₱2,316,768	₱1,900,418

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a. Year that proposed corporation would be established, with the MDA holding 51 percent of the shares.

b. End of tax-free development period for the corporation; an increase of 20 percent for the next five years is then applied.

c. Figures given are annual amounts.

d. Annual average over 15 years following 1977.

e. Total annual depreciation, excluding handpresses, is ₱589,683.

Source: Stanford Research Institute.

Manufacturing Cost of Palm Oil (per Ton) [Table 30, No. 2]

The following figures are based on a plantation in full bearing and a factory of 9 tons hourly milling capacity:

Factory labor	₱ 5.20
Repair and replacement	13.40
Fuel and lubricating oil	1.20
Upkeep of factory building	3.64
Laboratory (chemicals, utensils, analysis)	0.48
Factory water	1.20
Factory lighting	1.00
Miscellaneous: upkeep tanks, insurance on factory and machinery	4.80
Total	₱30.92

Transport Cost of Palm Oil (per Ton) [Table 30, No. 4]

The costs for transporting palm oil from the factory to Manila, shown in Table 30, are based on the bulk transport costs rather than shipments by drum, since, as will be shown in the following discussion, bulk transport costs are considerably less.

Consider first the costs of transporting palm oil in drums from the factory to Jolo harbor by truck and then shipping it to Manila. (The buyer and seller of the oil should make an agreement regarding the return of the empty drums for re-use.) Assuming that the 55-gallon drums (200 liters, gross weight about 195 kg, net 172 kg of oil) could be used 20 times before getting rusty inside, the transport cost per ton of oil from the factory to Manila, would be as follows:

Required 1,000/(172 x 20) drums @ ₱33 =	₱ 9.59
Transport of drums and oil to Jolo harbor (distance 35 km, ₱0.34 per ton km)	11.90
Transport empty drums	1.49
Stevedoring (handling, hauling) at Jolo harbor	4.07
Stevedoring empty drums	1.02
Freight from Jolo to Manila, full and empty drums, ₱19.75 per cubic meter	45.94
Stevedoring at Manila	5.09
Total	₱79.10

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The production cost of a ton of palm oil delivered at Manila would amount to ₱30.92 (manufacturing) plus ₱79.10 (transport, or ₱110.02.

In view of the high cost of drum transport (nearly ₱80 per ton of oil) from factory to Manila, in this study bulk transport is assumed to take place as now is being done for coconut oil. This could be done by using tanker trucks for bringing the oil from the factory to the reception facilities in Jolo harbor, where it could be pumped into a seagoing tanker. The more attractive solution, however, is to pump the oil directly from the factory's storage tank near the plantation's own wharf into a seagoing tanker.

Pumping costs	₱10.00
Shipping freight to Manila	20.00
Total per ton of oil	₱30.00

This cost figure for bulk transport, far more favorable than that of drum transport, is used in Table 30 and subsequent calculations. The production cost of palm oil delivered at Manila by sea tankers amounts to ₱30.92 (manufacturing) plus ₱30 (pumping and shipping) or ₱60.92, which is ₱49.10 per ton cheaper than drum transport.

Manufacturing Cost of Palm Kernels (per Ton) [Table 30, No. 3]

Factory labor	₱ 3.20
Fuel and lubricating oils	2.10
Upkeep of plant; repairs and replacement	6.32
Laboratory (chemicals, analysis, etc.)	0.16
Miscellaneous, including insurance	6.00
Packing labor	1.26
Total	₱19.04

Transport Cost of Palm Kernels (per Ton) [Table 30, No. 5]

The following figures pertain to shipping kernels (in bags) from the factory to Manila.

12.5 bags of 80-kg net capacity	₱25.00
Transport to Jolo Harbor, 35 km	10 50
Stevedoring at Jolo	2.00
Freight from Jolo to Manila ₱19.75 per cubic meter	36.00
Stevedoring at Manila	2.00
Total	₱75.50

The total cost of the palm kernels delivered in bags at Manila would amount to ₱19.04 (manufacturing) plus ₱75.50, or ₱94.54. Shipping via a plantation wharf, as assumed above, would reduce the transport cost by ₱11.00 to ₱64.50 or a total of ₱83.54.

As regards the calculation of the cost of production of palm kernels, different procedures can be followed in allotting various cost charges. The indirect and fixed costs can (1) be spread over oil and kernels produced, or (2) be calculated on the basis of oil only. Both methods, which lead, of course, to the same results as regards total profits from oil plus kernels, have been worked out, but only the second method is used in this study for further calculations.

Upkeep of Buildings (Excluding Factory Buildings) [Table 30, No. 6]

Upkeep ₱60,000 annually from 1978

1.	82% to oil = ₱49,200	per ton of oil, ₱9.84
	18% to kernels = ₱10,800	per ton of kernels, ₱10.14
2.	100% to oil =	per ton of oil, ₱12.00

Repair and Maintenance [Table 30, No. 7]

Vehicular equipment	₱342,000	
Tools, machinery equipment	235,500	
3% of total value	₱577,500	= ₱17,325 maintenance annually from 1978

1.	82% to oil = ₱14,207	per ton of oil, ₱2.84
	18% to kernels = ₱3,118	per ton of kernels, ₱2.93
2.	100% to oil =	per ton of oil, ₱3.47

Materials [Table 30, No. 8]

Fuel and oil for vehicular equipment ₱7,000 annually from 1978

1. 82% to oil = ₱5,740	per ton of oil, ₱1.15
18% to kernels = ₱1,260	per ton of kernels, ₱1.18
2. 100% to oil =	per ton of oil, ₱1.40

Indirect Costs

Administration and Supervision [Table 30, No. 9]

General cost overhead payroll	₱275,700
15% fringe benefits including social security	41,355
	₱317,055
Administrative and hospital expenses	25,000
	₱342,055

1. 82% to oil = ₱280,485	per ton of. oil, ₱56.10
. 18% to kernels = ₱61,570	per ton of kernels, ₱57.81
2. 100% to oil =	per ton of oil, ₱68.41

Annual Fixed Costs

Taxes (at 1 percent) on Fixed Capital Investments* [Table 30, No. 10]

Buildings	₱ 924,000
Vehicular equipment	342,000
Machinery, etc.	235,500
Factory	2,412 000
Land, wharf, etc.	1,750,000

1% of ₱5,663,500 = ₱56,635 tax

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* Taxes begin in 1980 at an increasing rate of 20 percent annually for five years if a corporation is formed in 1975.

1. 82% to oil = ₱46,441 — per ton of oil, ₱9.29

18% to kernels = ₱10,194 — per ton of kernels, ₱9.57

2. 100% to oil = — per ton of oil, ₱11.33

Insurance [Table 30, No. 11]

Buildings	₱ 924,000
Machinery, etc.	235,500
1% of	₱1,159,500 = ₱11,595 insurance cost

1. 82% to oil = ₱9,508 — per ton of oil, ₱1.90

18% to kernels = ₱2,087 — per ton of kernels, ₱1.96

2. 100% to oil = — per ton of oil, ₱2.32

Vehicular equipment	₱342,000
3% =	₱ 10,260 insurance cost

1. 82% to oil = ₱8,413 — per ton of oil, ₱1.68

18% to kernels = ₱1,847 — per ton of kernels, ₱1.73

2. 100% to oil = — per ton of oil, ₱2.05

Depreciation [Table 30, No. 12]

Land development — ₱3,120,000 in 18 years = ₱173,333 annually

1. 82% to oil = ₱142,133 — per ton of oil, ₱28.43

18% to kernels = ₱31,200 — per ton of kernels, ₱29.30

2. 100% to oil = — per ton of oil, ₱34.67

Factory building	₱ 312,000	
Other buildings	₱ 924,000	
	₱1,236,000 in 10 years = ₱123,600 annually	
1. 82% to oil = ₱101,352		per ton of oil, ₱20.27
18% to kernels = ₱22,248		per ton of kernels, ₱20.89
2. 100% to oil =		per ton of oil, ₱24.72
Factory machinery	₱2,100,000	
All other machinery and equipment	235,000	
Vehicular equipment	342,000	
	₱2,677,500 in 10 years = ₱267,750 annually	
1. 82% to oil = ₱219,550		per ton of oil, ₱43.91
18% to kernels = ₱48,200		per ton of kernels, ₱45.25
2. 100% to oil =		per ton of oil, ₱53.55
Wharf and pumphouse	₱250,000 in 10 years = ₱25,000 annually	
1. 82% to oil = ₱20,500		per ton of oil, ₱4.10
18% to kernels = ₱4,500		per ton of kernels, ₱4.32
2. 100% to oil =		per ton of oil, ₱5.00

The estimated cost price figures discussed above are summarized in Table 31.

Table 31

ESTIMATED COST PRICE PER TON OF OIL AND KERNELS PRODUCED ON A FULL-BEARING 1,500-HECTARE OIL PALM PLANTATION

(Pesos)

Item	Oil	Kernels
Field cost	₱165.73	
Manufacturing cost	30.92	₱19.04
Transportation	30.00	64.50
Upkeep of buildings	12.00	
Repair and maintenance	3.47	
Materials	1.40	
Administration and payroll	68.41	
1% tax on capital investment	11.33	
Insurance		
Facilities	2.32	
Vehicular equipment	2.05	
Depreciation[a]		
Plantation (land development)	34.67	
Facilities	24.72	
Machinery, equipment, and transportation	53.55	
Wharf and pumphouse	5.00	
Cost price before interest and taxes	₱445.57	₱83.54

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[a] Depreciation over 10 years, except plantation taken over 18 years.

Source: Stanford Research Institute.

Selling Prices

Palm Oil, Home Market (Manila)

On the basis of the actual landed cost of palm oil in Manila, amounting to ₱1,230-₱1,350 per ton, it is conservatively assumed that domestically produced palm oil would command a selling price of ₱1,150.

In assuming this figure it is considered that if palm oil were offered in larger quantities it would affect the utilization of other oils for certain end-uses, since various oils are technically interchangeable. In this connection it is noted that the Manila prices of the two most important oils in this respect, viz., internally produced coconut oil and imported tallow, are ₱881 and ₱1,100 per ton, respectively.

Palm Oil, World Market

The world market c.i.f. prices of palm oil are £80-£85, or approximately US$220-$235, or ₱880-₱940 per ton. It is estimated that these figures correspond with an f.o.b. Manila price of about ₱650, which is the amount used in the calculations. The author is aware of the great risk involved in assuming this selling price for home-produced palm oil. The estimates of the selling price of both oil and kernels are the weaker points in the calculations of the economics of any oil palm project. The production cost data are as accurate as possible, but very rough estimates have had to be made for one of the most important variables, viz., the selling price.

Kernels, World Market

On the basis of a c.i.f. world market price of £55 or approximately US$152.50 or ₱610, the f.o.b. value is assumed to be roughly ₱450 per ton of kernels. Selling the oil on the home market and exporting the kernels would give (in pesos per ton):

	Oil	Kernels
Selling price	₱1,150	₱450
Cost price	446	84
Gross profit	₱ 704	₱366
30% taxes	211	110
Profit before interest	₱ 493	₱256

These figures multiplied by their respective tonnages of 5,000 and 1,065 yield an annual profit, before interest, of

493 × 5,000 = ₱2,465,000
256 × 1,065 = 272,640
₱2,737,640

This shows, as a first indicator, an annual return (before interest) of 27 percent of the invested capital in establishing the plantation (approximately ₱10 million) during the 18 years of full bearing (1978-95).

If both the kernels and the oil were sold on the world market, the picture would be as follows (in pesos per ton):

	Oil	Kernels
Selling price, f.o.b. Manila	₱650	₱450
Cost price	446	84
Gross profit	₱204	₱366
30% taxes	61	110
Profit before interest	₱143	₱256

These figures multiplied by their respective average tonnages of 5,000 and 1,065 yield an annual profit, before interest, of

143 × 5,000 = ₱715,000
256 × 1,065 = 272,640
₱987,640

The ratio of profit before interest to total investment would be roughly 10 percent during the years of full bearing.

Other Economic Factors

The following assumptions are made in considering the feasibility of a plantation at Jolo:

1. The plantation is financed as discussed in the next section.

2. All the oil produced is sold on the home market; the palm kernels are exported. Since the internal demand for palm oil is now some 5,000 tons a year and this demand is expected to increase by 3 to 5 percent a year, it may be assumed that when the whole plantation is in production (from 1974 on) there will be ready market in the Philippines for palm oil produced on the Jolo plantation.

   From 1978 on, this plantation should produce an average of 5,000 tons of palm oil per year; the domestic demand is expected to be some 8,000 tons in 1978 and some 11,000 tons by 1995.

   It may be mentioned that there are good possibilities for selling the palm oil on the world market. Had the feasibility study considered sales on the world market on the basis of world market prices rather than local prices, under the proposed method of financing, the profits as indicated in the study would not have been as large. Nevertheless, the study would prove to be feasible.

3. Oil processing during the first four years of low production (1971-74) is handled by the Stork hydraulic handpresses. It is assumed that during these years the kernels cannot be recovered but can be used, still in their shells, as fuel for the processing of oil. The monetary value of the nuts (shells, plus kernels) as a fuel is estimated and considered as income during these first four years.

   The fuel for a palm oil factory is normally supplied by the nut shells, the pericarp residue, and a part of the empty fruit bunches. The bulk of the bunch waste can be used as organic manure. However, in the initial operation of a plantation, when the production is low, the fuel materials mentioned above are not sufficient and must be supplemented with a certain amount of firewood, which normally is available in large quantities in the cleared forest areas. Since wood on the Kiram property and in the surrounding areas is available in a very limited quantity (only some teak), the use of the kernels as a fuel is a valid assumption. Both nut shells and kernels have a high caloric value.

X ECONOMICS AND YIELD ESTIMATES FOR THE PROPOSED OIL PALM PLANTATION PROJECT

Financing

One suggested method of financing the proposed oil palm plantation is to consider the plantation as a direct activity of the MDA throughout the entire period, so that all direct and indirect charges would be paid from MDA's appropriated funds, and profits would accrue directly to the MDA. It is noted in Table 32 that a net profit would not be made until 1975. By that time there would be a total investment of ₱11,716,928 comprising ₱9,285,200 capital investment plus ₱4,109,728 (Table 30) operating costs, less ₱1,678,000 income received (Table 32).

From 1975 through 1995, or 20 years, the plantation will remain in full operation, after which programming for replanting such as that used in the original planting schedule should be considered. In the 1975-95 period, the MDA will have received a total net inflow of ₱85,366,232, of which ₱78,332,738 will be net profit and ₱7,033,494 will be depreciation reserves. It is assumed that as an activity of the MDA, the plantation will not be subject to taxation during this period. The funds so received could therefore be directed into other activities being promoted by the MDA.

An alternative system of financing to be considered is the establishment of a corporation so that the MDA can receive back part of its investment through the sale of shares to the private sector. The plantation could be incorporated in the year 1975, at which time the MDA will have a total investment in the plantation of ₱11,716,928. Tables 33 and 34 show estimated cash flow and profit-and-loss statements under this method of financing.

The corporation could be capitalized at ₱8 million, 51 percent of the shares, or ₱4,080,000, to be subscribed by the MDA, and 49 percent of the shares, or ₱3,920,000, to be sold. In selling these shares of stock consideration might be given to selling part to the organization represented by the plantation manager, if such terms were considered in initiating the oil palm plantation. Such an arrangement might be a special inducement to obtain competent management, which is a key to a successful operation.

Table 32

ESTIMATED CASH FLOW OF THE PROPOSED 1,500-HECTARE OIL PALM PLANTATION, JOLO[a]
1967-1978
(Pesos)

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Sources of Funds												
1. Income from operations	₱ —	₱ —	₱ —	₱ —	₱(903,088)	₱ (810,153)	₱ (579,987)	₱(138,500)	₱690,433	₱1,452,782	₱2,238,617	₱3,969,117
2. Depreciation	—	—	—	—	730	3,650	10,800	24,820	—	—	—	564,683
3. Income before taxes and interest (1 + 2)	₱ —	₱ —	₱ —	₱ —	₱(902,358)	₱ (806,503)	₱ (569,187)	₱(113,680)	₱690,433	₱1,452,732	₱2,238,617	₱4,533,800
4. Advances from MDA	2,406,350	709,550	1,247,150	1,571,950	556,000	1,353,400	1,317,600	123,200	—	—	—	—
5. Total (3 + 4)	₱2,406,350	₱709,550	₱1,247,150	₱1,571,950	₱(346,358)	₱ 546,897	₱ 748,413	₱ 9,520	₱690,433	₱1,452,782	₱2,238,617	₱4,533,800
Utilization of Funds												
6. Field charges	180,750	350,750	726,250	997,250	403,000	300,000	162,000	—	—	—	—	—
7. Buildings	297,000	100,000	194,000	203,000	130,000	—	—	—	—	—	—	—
8. Transportation	222,000	12,500	64,500	43,000	—	—	—	—	—	—	—	—
9. Machinery, equipment, tools	49,500	58,500	38,500	45,000	23,000	21,000	—	—	—	—	—	—
10. Personnel	157,100	187,800	223,900	275,700	—	—	—	—	—	—	—	—
11. Factory	—	—	—	8,000	—	1,032,400	1,155,600	123,200	—	187,000	187,000	—
12. Land	1,500,000	—	—	—	—	—	—	—	—	—	—	—
13. Wharf and pumphouse	—	—	—	—	—	—	—	—	50,000	100,000	100,000	—
14. Total capital investment (6 to 13)	₱2,406,350	₱709,550	₱1,247,150	₱1,571,950	₱ 556,000	₱1,353,400	₱1,317,600	₱ 123,200	₱ 50,000	₱ 287,000	₱ 287,000	₱ —
15. Income tax	—	—	—	—	—	—	—	—	—	—	—	—
16. Total use of funds (14 + 15)	2,406,350	709,550	1,247,150	1,571,950	556,000	1,353,400	1,317,600	123,200	50,000	287,000	287,000	—
17. Cash inflow (5 - 16)	—	—	—	—	(902,358)	(806,503)	(569,187)	(113,680)	640,433	1,165,782	1,951,617	4,533,800
18. Net profit (or loss)	—	—	—	—	(903,088)	(810,153)	(579,987)	(138,500)	690,433	1,452,782	2,238,617	3,969,117

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a. Based on financing plantation as direct activity of MDA.

Cash inflow, 1975-77	₱ 3,757,832
1978-95	81,608,400
	₱85,366,232
Depreciation fund, 1978-95	7,033,494
Net profit, 1975-95	78,332,738
	₱85,366,232

Source: Stanford Research Institute.

It is suggested that the remaining shares be sold to the people in the community so that they might participate in the net profits. This system would have the advantage of raising the living standards of the local population. At the time of sale, arrangements might be considered to develop a program for the sale of shares on a deferred-payment basis, should the economic conditions justify such a method. The participation of the people in the community as part owners might help to ease the problems of "peace and order." The ₱3,920,000 received by the MDA from the sale of the shares would, of course, represent a return to the MDA of part of its initial investment. The 49-51 percent ownership would permit the plantation, as a subsidiary of the MDA, to take advantage of the tax-free holiday for the first five years of its operation and the second five years in which there is an increasing tax of 20 percent a year.

The difference between the ₱8 million capitalization and the ₱11,717,000 invested by the MDA through 1974, or ₱3,717,000, would be considered as a loan from the MDA to the corporation, to be retired over a 15-year period with 8 percent interest. This would provide an additional income to the MDA, not counting its share of the net profits.

Furthermore, since the suggested plantation covers 1,500 hectares, and a corporation, under Philippine law, can consist of not more than 1,024 hectares, the difference, or 476 hectares, would bring in an additional income to the MDA under a lease agreement between the MDA and the corporation, to be arranged at the time of incorporation.

The installation of a pier and the final expansion of the factory would be necessary after incorporation. Rather than capitalize these expenditures, which cover the three-year period 1975-77, or deducting them from the annual net profits, it is suggested that these expenditures be financed by short-term bank loans at the rate of 8 percent, the loans to cover a two-year period. This method, rather than financing from net profits, makes the annual return per share more attractive to the potential buyer. Under the suggested method of short-term loans, a ₱50,000 loan would be obtained in 1975, a ₱287,000 loan in 1976, and a ₱287,000 loan in 1977. These expenditures bring the entire investment to ₱12,340,928.

It will be noted in the cash flow statement of Table 34 that under this arrangement, considering the amortization of the MDA's 15-year loan and the short-term loans proposed, there will be a net profit in 1975 of ₱500,940, or 6.3 percent return per share. In the cash flow statement, depreciation is not shown during the 1975-78 period, since in the operation of the plantation charges for depreciation have been included during this period as operating costs. This factor is indicated in the sections

Table 33

STATEMENT OF ESTIMATED PROFIT AND LOSS FOR THE PROPOSED 1,500-HECTARE OIL PALM PLANTATION, JOLO[a] 1971-1995 (Pesos)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984-87
Sales of palm oil, home market	₱ 28,750	₱ 143,750	₱ 425,500	₱ 977,500	₱1,713,500	₱2,512,750	₱3,335,000	₱5,750,000	₱5,750,000	₱5,750,000	₱5,750,000	₱5,750,000	₱5,750,000	₱5,750,000
Sales of palm oil and kernels, world market	--	--	--	--	211,950	278,550	334,350	479,250	479,250	479,250	479,250	479,250	479,250	479,250
Fuel value of kernels	2,500	10,000	30,000	60,000	--	--	--	--	--	--	--	--	--	--
Total revenue sources	₱ 31,250	₱ 153,750	₱ 455,500	₱1,037,500	₱1,925,450	₱2,791,300	₱3,669,350	₱6,229,250	₱6,229,250	₱6,229,250	₱6,229,250	₱6,229,250	₱6,229,250	₱6,229,250
Less cost of sales before taxes and interest	934,338	963,903	1,035,487	1,176,000	1,235,017	1,338,518	1,430,733	2,260,133	2,260,133	2,271,460	2,282,787	2,29[illegible],114	2,305,441	2,316,768
Gross profit (or gross loss)	₱(903,088)	₱(810,153)	₱ (579,987)	₱ (137,500)	₱ 690,433	₱1,452,782	₱2,238,617	₱3,969,117	₱3,969,117	₱3,957,790	₱3,946,463	₱3,935,136	₱3,923,809	₱3,912,482
Less interest	--	--	--	--	189,493	206,933	221,335	203,895	186,455	186,455	186,455	186,455	186,455	186,455
Gross profit before taxes	₱ --	--	₱ --	₱ --	₱ 500,940	₱1,245,849	₱2,017,282	₱3,765,222	₱3,782,662	₱3,771,335	₱3,760,008	₱3,748,681	₱3,737,354	₱3,726,027
Less income tax	--	--	--	--	--	--	--	--	--	226,280	451,201	674,762	896,965	1,117,808
Net profit (or net loss) after taxes	₱(903,088)	₱(810,153)	₱ (579,987)	₱ (138,500)	₱ 500,940	₱1,245,849	₱2,017,282	₱3,765,222	₱3,782,662	₱3,545,055	₱3,308,807	₱3,073,919	₱2,840,389	₱2,608,219
Net profit/total investment[b] (percent)	--%	--%	--%	--%	4.6%	10.3%	16.3%	30.5%	30.7%	28.7%	26.8%	24.9%	23.0%	21.1%
Net profit/equity capital[c] (percent)	--%	--%	--%	--%	6.3%	15.6%	25.2%	47.1%	47.3%	44.3%	41.4%	38.4%	35.5%	32.6%

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a. Financing based on plantation incorporated in 1975.

b. Total investment of ₱12,340,928 attained in 1978.

c. Equity capital - ₱8,000,000.

Source: Stanford Research Institute.

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Table 3

ESTIMATED CASH FLOW OF THE PROPOSE
1967-19
(Pesos

	1967	1968	1969	1970	1971	1972	1973	1974
Sources of Funds								
1. Income from operations	₱ --	₱ --	₱ --	₱ --	₱(903,088)	₱ (810,153)	₱ (579,987)	₱(138,5
2. Depreciation[b]	--	--	--	--	730	3,650	10,800	24,8
3. Income before taxes and interest (1 + 2)	--	--	--	--	₱(902,358)	₱ (806,503)	₱ (569,187)	₱(113,6
4. Amortization fund MDA, loan	--	--			--	--	--	.
5. Advance from MDA	2,406,350	709,550	1,247,150	1,571,950	556,000	1,353,400	1,317,600	123,2
6. Private share (49%)	--	--	--	--	--	--	--	.
7. MDA share (51%)	--	--	--	--	--	--	--	.
8. Short-term loan (two years)	--	--	--	--	--	--	--	.
9. Total (3 to 8)	₱2,406,350	₱709,550	₱1,247,150	₱1,571,950	₱(346,358)	₱ 546,897	₱ 748,413	₱ 9,5
Utilization of Funds								
10. Field charges	180,750	350,750	726,250	997,250	403,000	300,000	162,000	
11. Buildings	297,000	100,000	194,000	203,000	130,000	--	--	
12. Transportation	222,000	12,500	64,500	43,000	--	--	--	
13. Machinery, equipment, tools	49,500	58,500	38,500	45,000	23,000	21,000	--	
14. Personnel	157,100	187,800	223,900	275,700	--	--	--	
15. Factory	--	--	--	8,000	--	1,032,400	1,155,600	123,2
16. Land	1,500,000	--	--	--	--	--	--	
17. Wharf and pumphouse	--	--	--	--	--	--	--	
18. Total capital investment (10 to 17)	₱2,406,350	₱709,550	₱1,247,150	₱1,571,950	₱ 556,000	₱1,353,400	₱1,317,600	₱ 123,2
19. Debt service								
Payment of long-term loan[c]	--	--	--	--	--	--	--	
Payment of short-term loan[d]	--	--	--	--	--	--	--	
20. Total debt service	--	--	--	--	--	--	--	
21. Income tax	--	--	--	--	--	--	--	
22. Total utilization of funds (18 to 21)	2,406,350	709,550	1,247,150	1,571,950	556,000	1,353,400	1,317,600	123,2
23. Cash inflow (9 - 22)	--	--	--	--	(902,358)	(806,503)	(569,187)	(113,6
24. Net profit (or loss) (23 - 2)	--	--	--	--	(903,088)	(810,153)	(579,987)	(138,5

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a. Financing based on plantation as corporation with MDA holding 51 percent of the shares.
b. Depreciation through 1967 to 1978 has been considered as an operating cost with the exception of the handpresses, which are d
c. Loan from MDA, payable at 8 percent interest for 15 years.
d. Includes payments of ₱28,038 on ₱50,000 loan, and of ₱160,940 on two ₱287,000 loans, over two years at 8 percent interest.

Source: Stanford Research Institute.

Table 34

THE PROPOSED OIL PALM PLANTATION, JOLO[a]
1967-1984
(Pesos)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
37)	₱(138,500)	₱ 690,433	₱1,452,782	₱2,238,617	₱3,969,117	₱3,969,117	₱3,957,790	₱3,946,463	₱3,935,136	₱3,923,809	₱3,912,482
)0	24,820	--	--	--	564,683	564,683	564,683	564,683	564,683	564,683	564,683
37)	₱(113,680)	₱ 690,433	₱1,452,782	₱2,238,617	₱4,533,800	₱4,533,800	₱4,522,473	₱4,511,146	₱4,499,819	₱4,488,492	₱4,477,165
--	--	272,800	416,300	534,800	391,300	247,800	247,800	247,800	247,800	247,800	247,800
)0	123,200	--	--	--	--	--	--	--	--	--	--
--	--	3,920,000	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	50,000	287,000	287,000	--	--	--	--	--	--	--
13	₱ 9,520	₱4,933,233	₱2,156,082	₱3,060,417	₱4,925,100	₱4,781,600	₱4,770,273	₱4,758,946	₱4,747,619	₱4,736,292	₱4,724,965
	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--
	123,200	--	187,000	187,000	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--
	--	50,000	100,000	100,000	--	--	--	--	--	--	--
	₱ 123,200	₱ 50,000	₱ 287,000	₱ 287,000	--	--	--	--	--	--	--
	--	434,255	434,255	434,255	434,255	434,255	434,255	434,255	434,255	434,255	434,255
	--	28,038	188,978	321,880	160,940	--	--	--	--	--	--
	--	₱ 462,293	₱ 623,233	₱ 756,135	₱ 595,195	₱ 434,255	₱ 434,255	₱ 434,255	₱ 434,255	₱ 434,255	₱ 434,255
	--	--	--	--	--	--	226,280	451,201	674,762	896,965	1,117,808
	123,200	512,293	910,233	1,043,135	595,195	434,255	660,535	885,456	1,109,017	1,331,220	1,552,063
	(113,680)	4,420,940	1,245,849	2,017,282	4,329,905	4,347,345	4,109,738	3,873,490	3,638,602	3,405,072	3,172,902
	(138,500)	500,940[d]	1,245,849	2,017,282	3,765,222	3,782,662	3,545,055	3,308,807	3,073,919	2,840,389	2,608,219

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hich are depreciated during the 1971-74 period.

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concerned. Were the charges removed from operating costs during the period, the reserves for depreciation would be the same as shown from 1978 on. The profit will increase annually throughout the period. It will be noted that in 1979, when the five-year tax holiday expires, there will be an estimated net profit of ₱3,782,662, or 47.3 percent of the equity capital. By that time, all the loans will have been paid except the 15-year loan to the MDA, which would be paid in 1989. In 1980, the net profit after payment of taxes is estimated at ₱3,545,055, or 44.3 percent of the capital investment. In 1984, when the remaining tax-exemption privileges will have expired, the net profit is estimated at ₱2,608,219, or approximately 32.6 percent of the capital. The MDA might then consider the retirement of its ownership, so that the funds received could be used for other development purposes, and the entire enterprise turned over to the private sector.

Yield Estimates Related to the Economics of the Project

The sale of palm oil on the home market under the financing conditions discussed has been shown to be a profitable operation. The production costs of the oil in the project under study are rather high, so that delivery on the world market would leave only a small profit under normal financing conditions.

There were several uncertainties confronted in estimating the yield of the Jolo plantation as pointed out above. The yield is the dominating factor with regard to the economics of palm oil production. Owing to a lack of information, it was assumed after ample consideration that both rainfall and soil quality in the Tiptipon area are suboptimal. On this basis it was concluded that an output of 3.5 tons of oil per hectare per year could reasonably be expected on the mature plantation.

Variable Environmental Factors

The profitability of the project would be increased substantially under any or all of the following conditions:

1. The rainfall is 80 inches instead of the 70 inches now assumed

2. The soil quality proves to be up to standard

3. The size of the plantation is enlarged to more than 1,500 hectares

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concerned. Were the charges removed from operating costs during the period, the reserves for depreciation would be the same as shown from 1978 on. The profit will increase annually throughout the period. It will be noted that in 1979, when the five-year tax holiday expires, there will be an estimated net profit of ₱3,782,662, or 47.3 percent of the equity capital. By that time, all the loans will have been paid except the 15-year loan to the MDA, which would be paid in 1989. In 1980, the net profit after payment of taxes is estimated at ₱3,545,055, or 44.3 percent of the capital investment. In 1984, when the remaining tax-exemption privileges will have expired, the net profit is estimated at ₱2,608,219, or approximately 32.6 percent of the capital. The MDA might then consider the retirement of its ownership, so that the funds received could be used for other development purposes, and the entire enterprise turned over to the private sector.

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Variable Environmental Factors

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1. The rainfall is 80 inches instead of the 70 inches now assumed

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3. The size of the plantation is enlarged to more than 1,500 hectares

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Rainfall. Even if the rainfall-data collection for the Kiram property were to begin now, no reliable basis for study could be expected within the next five years. Therefore, there was no choice but to base the calculations on the 70-inch measurement now available.

Soil and Soil Analysis. Only a limited number of soil samples could be collected (in the Kiram property at seven locations well distributed over the area, and in the Tandu Batu area at two locations); however, they may provide valuable information on the quality of the soil and on the requirements of fertilizers and cultural practices for oil palms on the Kiram property area, which in fact shows only slight apparent soil variations.

It could not be expected that the results of analysis of these samples, which were sent to the Soils Laboratory of the Royal Tropical Institute in Amsterdam for investigation, could be made available during preparation of this report in the Philippines.

This problem could not be solved by having the samples analyzed at a Philippine laboratory as was suggested to the author on several occasions. Such analysis work requires technicians conversant with both tropical soils and oil palm cultivation and experienced in the interpretation of the analysis results. Although Philippine soil experts and soil laboratories have already conducted valuable research, they are so far not in a position to advise on soil-improvement measures, including fertilizer requirements of the oil palm. For example, the Bureau of Soils has recommended that oil palms on Basilan Island be limed. During the field visit to the plantation, the author had already expressed serious doubt as to the validity of this recommendation. The preliminary results of analysis of some soil samples collected in the plantation concerned and recently investigated at the Royal Tropical Institute in Amsterdam show that indeed there is no need for liming and that lime may even do harm by hampering the uptake of potassium.

It will be clear that analysis results provided by a Philippine laboratory and obtained through their own special methods could not have been appropriate for interpretation in the Jolo study.

It is possible that on the basis of the findings of the Royal Tropical Institute, the author would revise certain estimates used for the Jolo plantation under study. Fertilization, for instance, the cost of which in the present study amounts to ₱55 per ton of oil (nearly 13 percent of the total cost price before interest) might be less expensive if the soil quality proves up to standard. It is even conceivable that the results of soil analysis would permit the yield estimate to be raised.

Comments and possibly revisions on certain estimates will be submitted as soon as the soil analysis results become available. At the same time, the Tandu Batu area, where some 800 hectares are available, can be considered as to soil quality and suitability for oil palms since soil samples were submitted for testing from that area.

The Size of an Oil Palm Plantation. Although an area of 1,500 hectares was selected at the Kiram property for an oil palm plantation, in palm oil production the most economic size of a plantation is some 2,000-5,000 hectares, in order to spread the high overhead costs over a large tonnage of produce.

A plantation size in the order of 1,000 hectares is often uneconomical, except under conditions of very high yields, such favorable factors as cheap labor and excellent location, or protected prices (in the case of delivery on the home market with prices much higher than the world price).

A plantation of 1,000 hectares under Jolo conditions would require a capital investment of about ₱7,000 per hectare against ₱6,606 in the case of the 1,500-hectare plantation under study, and the production cost per ton of oil would be substantially higher than the amount of ₱445.57 calculated for the 1,500-hectare plantation. It is tempting to compare the project under study with a plantation under optimal conditions, i.e., with an annual yield of 24 tons of bunches per hectare at 21.5 percent oil extraction.

Owing to higher oil content of the bunches (21.5 percent instead of 20 percent), under optimal conditions a larger quantity of oil is obtained for the same cost of production, harvesting, transport of the bunches, and processing of the bunches; this would mean a decrease in production cost per ton. Similarly, a much higher bunch yield per hectare (24 tons instead of 17.5 tons) would result in another reduction of the cost price. Finally, there would be a considerable reduction in cost price owing to the lower overhead cost per ton of produce. Although no detailed cost calculations for optimal conditions, which presumably prevail in Mindanao, could be worked out, a rough estimate was made of the field cost. This showed that the field costs per ton of oil under optimal conditions (24 tons) would be some 25 percent lower than those calculated for the 1,500-hectare Jolo plantation with the moderate yield of 17.5 tons of bunches.

The higher profit per ton of oil and kernels, with the highly increased output, clearly point to the advantages of growing oil palms under the best possible conditions and over a sufficiently large area. It is understandable why the internationally operating oil palm concerns normally establish their plantations at a size on the order of 3,000 to 5,000 hectares and under good conditions. By doing so, they can produce at low cost and are able to compete successfully on the world market, which shows an increasing demand for palm oil and palm kernels.

Appendix A

TIPTIPON SERIES*

This is a newly established soil series first identified in Tiptipon, Jolo. Soils of this series were developed from volcanic rocks of basalt and andesite. The relief is nearly level to slightly undulating, sloping to hilly in the eastern and western sides. The internal and external drainage are both good. This is a deep soil with coarse skeleton neither on the surface soil nor in the profile. Tiptipon clay loam is the only soil type classified with the following profile characteristics.

Depth (cm)	Characteristics
0-30	Surface soil, brown to dark brown clay loam to clay, fine granular structure, porous and friable. Moderately sticky and plastic when wet, and moderately hard when dry. Affords good root penetration. Boundary with subsoil is clear and smooth.
30-70	Subsoil, brown to light brown fine granular clay loam to clay, porous and friable, moderately plastic when wet but easily crumbles with optimum moisture content. Moderately hard when dry. Affords good root penetration. No coarse skeleton. Boundary with substratum is clear and smooth.
70-over 150	Substratum, light brown to yellowish brown clay loam, fine granular, porous and friable. This is underlain by highly weathered volcanic rocks.

Information on the soil series is from Soil Survey of Sulu Province, Soil Report No. 35, Bureau of Soils (to be published).

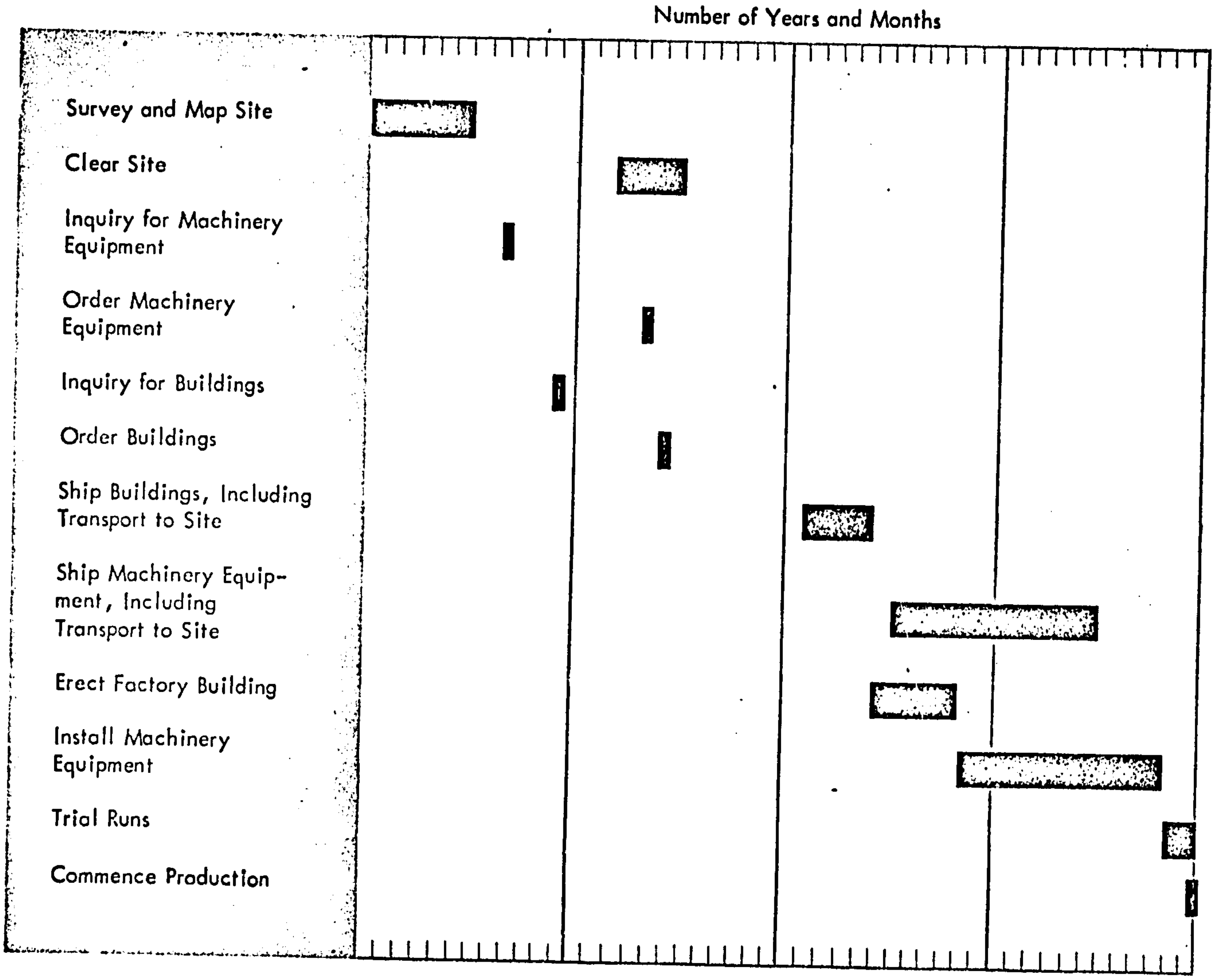
Tiptipon Clay Loam (856)

This soil type represents the newly established soil series with an approximate area of 10,520 hectares. The external and internal drainage conditions are both good. The topography varies from level and slightly undulating to sloping and hilly. Hills are found in the eastern and western sides with an elevation of 400 to 700 feet above sea level suited for rubber trees. In the level sections upland rice, corn, banana, coconut, abaca, and tubers are cultivated. Permanent fruit trees in the undulating to sloping areas are recommended. The sloping sections, especially those in the two hills are under cogon and sporadic growth of the binayoyo tree.

This soil type is located in the vicinity of Taglibi, upper Bunbun, northern Bilaan, Tiptipon to Seit, and in Siasi. In Tiptipon, upland rice culture is done by mechanized farming methods. Depressed areas are often planted in vegetables.

APPENDIX B

PROPOSED SCHEDULE FOR ESTABLISHING A PALM OIL FACTORY



SOURCE: Gebr. Stork & Co's, Apparatenfabriek N.V., Amsterdam.